User Manual

VLM500-MID

Version 1.0

ASTECH
Angewandte Sensortechnik

Remarks

The information provided in the manual on hand have been carefully investigated and processed. Still, we cannot assume any kind of liability regarding completeness or mistakes. However, we are always grateful to get feedback and proposals.

Claims for damages are, except in the case of premeditation or negligence, in principle excluded.

As a series of versions of this product is available, deviations from the manual on hand might occur, if applicable.

We reserve ourselves the right to implement technical modification that serves to optimize of the product without related notification. Thus, it cannot be assumed that subsequent product versions show the same properties as the one on hand.

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VLM500-MID – User Manual V1.0

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1 General information

1.1 Information on how to work with this manual

Commands and functions are displayed in italics. The use of upper case and lower-case letters serves for improving the readability:

e.g. SO2On (Command for switching on the output at the serial interface S2).

The abbreviated form recommended for the input is additionally displayed in bold letters in the syntax:

e.g. SO1Format (Command for programming the serial interface 1).

The following signs are used:

n	Integral number	s	String
f	Floating point number	[ ]	Optional
c	Sign		

The following acronyms are used for the measurement parameters:

V	Velocity	N	Object counter
L	Length	R	Measuring rate

1.2 Safety instructions

These safety and operating instructions should be carefully read and followed during practical work with the device. Compliance with all specified operating conditions is necessary. Failure to observe advisory notes or nonconforming product usage may cause material damage to the VLM500-MID or lead to wrong measurement results. Cable connectors must not be plugged or unplugged under voltage. Remember to turn voltage supply off before you begin working on cable connections.

A light emitting diode (LED) is used as the light source for the VLM500. The LED classification is subject to the potential photobiological hazard according EN/IEC 62471 named “Photobiological safety of lamps and lamp systems”. They are not classified according EN 60825 “Safety of laser products”. The lamp of the VLM500 is classified to the risk group RG-2 (moderate risk) according to the manufacturer. That means that the lamp represents no hazard due to the natural reaction to look away from bright light sources. The following advice should be considered anyhow.

Do not stare at operating lamp. It may be harmful to the eye.

Machine directive 2006/42/EC

In the sense of the EU directive “2006/42/EC” the VLM500-MID is not a machine. Hence there is no conformity declaration available for the device. The directive 2006/42/EC regularizes the requirements on machines. Here, a machine is meant to be the entity of connected parts or mechanisms (see also EN 292-1, section 3.1). The VLM500-MID is part of the electrical and sensor equipment of a machine. The machine manufacturer must consider the VLM500-MID in its process for the declaration of conformity.

2 Device description

2.1 Intended use

The measuring device for velocity and length VLM500-MID (the known VLM500 connected with a device to store and display the measured length values, CDB) is suited for measurements on different materials. The scope of applications of the VLM in process automation is an extremely wide one. Typical applications are length measurement of web-type materials and the cutting control or post-control of sheets, profiles and tubes.

The VLM500-MID is designed for the integration into a length measuring machine (LMM). Dependent on the intended use of the LMM, a calibration of the machine according to the local authorities, can be necessary. In this sense the VLM500-MID is treated as counter. The counter was pre-tested by the national certification body „Physikalisch Technische Bundesanstalt (PTB)“ located in the city of Braunschweig, Germany. With the purchase of the VLM500-MID the customer receives the confirmation, that the device corresponds to the requirements of the software guide WELMEC 7.2. This guide provides technical guidance for the application of the Measuring Instruments Directive (MID 2014/32/EU), for software-equipped measuring instruments.[1] This simplifies the integration and the calibration process for plant manufacturers.

2.2 Two components – one device

General

The VLM500-MID consists of the two main components VLM500 and CDB. The VLM500 is the sensor. The CDB is a display and storage unit. The length values recorded by the VLM500 are displayed on the CDB screen. When a length measurement has been completed, the length value is saved together with status information as a data record in the CDB. If necessary, the data record can also be output via a digital interface. The user can navigate through a user interface using four buttons located below the display, call up saved measured values and print them out if necessary. In unsecured mode, the VLM500-MID is parameterized via a serial communication interface. Both units are connected with a cable.[2] The CDB is supplied with power from the VLM500 via this connection. Furthermore, the data exchange between the modules takes place via the cable. The housing of both units is IP 65 rated. The power supply is done with 24 VDC.

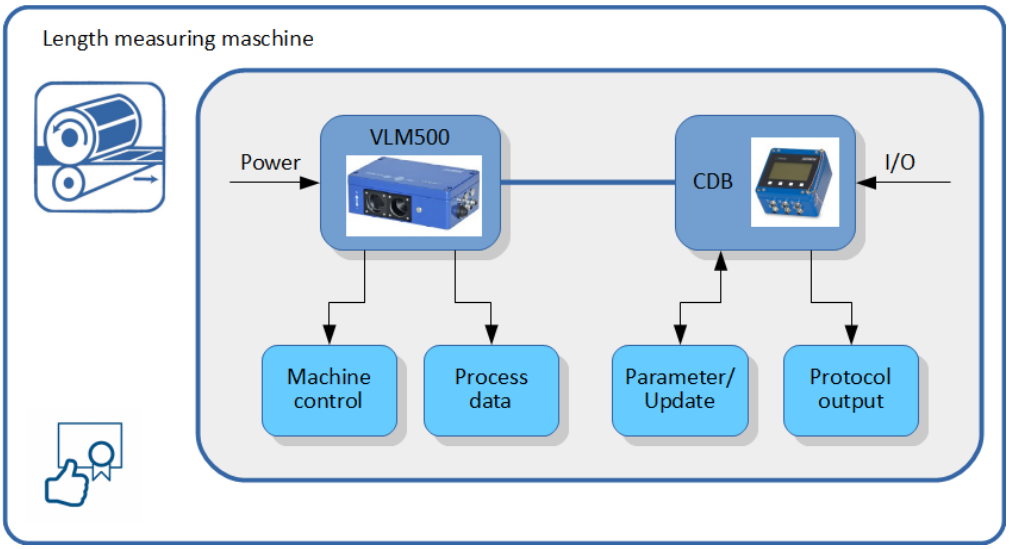


Figure 1: The VLM500-MID as a part of a length measuring machine

[1] The VLM500-MID fulfills the accuracy class III according to the measuring instrument directive.
[2] The customer can select between 5m and 10m cable length.

Interfaces

The VLM500-MID provides different interfaces for the integration into a length measuring machine. There is an optional dedicated digital protocol interface (RS232, USB, RS422/RS485, ProfiNet, Ethernet/IP, Ethernet) in the CDB available to share the length measurement protocols. If the protocol needs to be printed out, a serial printer interface is available by default. The VLM500 can be equipped with an optional analog interface (current interface 4-20mA) to connect a gauge for visualizing the actual speed or measurement rate. For machine control up to three pulse outputs and an additional field bus interface (ProfiNet, Ethernet/IP, Ethernet) can be installed in the VLM500.

CDB unit

The CDB (Control-Display-Box) is a combined display, control and storage unit. It shows the values transmitted by the VLM500 on the LCD (liquid crystal display). In addition to the length, the current speed and the measuring rate are also displayed. Further information shown on the screen are the current time and date.

If a triggered length measurement takes place, the final length value is automatically and permanently stored as a data record in the integrated non-volatile memory together with further information, like length unit, time, date. In the case of a manual length measurement, the measured value must be confirmed by pressing a key so that it can be saved automatically.

If the VLM500-MID is equipped with a data interface, this data record is automatically output to the data interface (not legally relevant). Furthermore, metadata (e.g. batch number, article number) can be transmitted to the CDB for protocol purposes. These can be changed continuously (e.g. for a changing article number) and are permanently stored together with the data record in the integrated non-volatile memory. They are not legally binding. The metadata is also printed on the optional label and transferred to the data interface.

With the help of the buttons located below the display, the user can navigate through a menu structure and call up saved measured values and other information about the device. Further information on using the CDB can be found in chapter 5.

Programming

The device is set and parameterized via a USB interface installed in the CDB. Necessary parameter settings or firmware updates can be made with the parameterization software VLMTool. This comfortable application is available to the user free of charge and can be installed on several Windows PCs. The individual commands of the VLM500-MID are described in chapters 12 and 13. The set parameters can be saved permanently in the device.

2.3 Measuring principle

The VLM500-MID works contact-free optically and implements the physical principle of the spatial filter[3] on the basis of a charged coupled device sensor (CCD): Optically resolvable structures of the material surface are displayed on the CCD sensor. This converts the movement directly into a frequency from which the velocity is calculated. A consecutive internal integration calculates the length. The internal integration can simply be controlled via an external signal (Start/Stop via the input: Trigger). The calculation of the velocity and the integration of the length are implemented signed. The direction can be controlled via an external signal. An automatic direction detection is optionally available.

The function of the VLM500 can be described in a simplified way as follows:

The lens is aligned with the moving object to be measured. The measurement object is mapped onto the CCD line using a combination of lenses. The optical grating is implemented using a special scanning process for the CCD line. The CCD line does not record images in the traditional sense. A built-in light source in the form of a

[3] Spatial filter is a generic term of a measurement principle for contact-free determination of velocity and length of moving materials. The spatial filter is based on the filtering effect of grid-shaped structures.

white light LED is used to illuminate the measurement object. Due to the broadband nature of the light, the greatest possible degree of surface independence is achieved. Any extraneous light that occurs is effectively suppressed by using a differential measurement method.

When the object moves, the optical grating produces a frequency that is proportional to its speed, i.e. the structure of the measurement object (contrast differences) generates an analog signal that is sinusoidal. This signal is called “burst”. After filtering these bursts, the device evaluates them. The signal frequency f_{Signal} is measured and the speed v is calculated from this with the aid of a proportionality factor k. The proportionality factor is significantly influenced by the imaging optics and other device-specific parameters. The following applies:

$$v = f_{Signal} \cdot k$$

To adapt the VLM500 to the speed of the measurement object or its reflection behavior, control loops are implemented in the device that allow automatic adaptation to a wide variety of materials (surface structure and brightness of the material). Figure 2 shows a simplified internal structure of the VLM500.

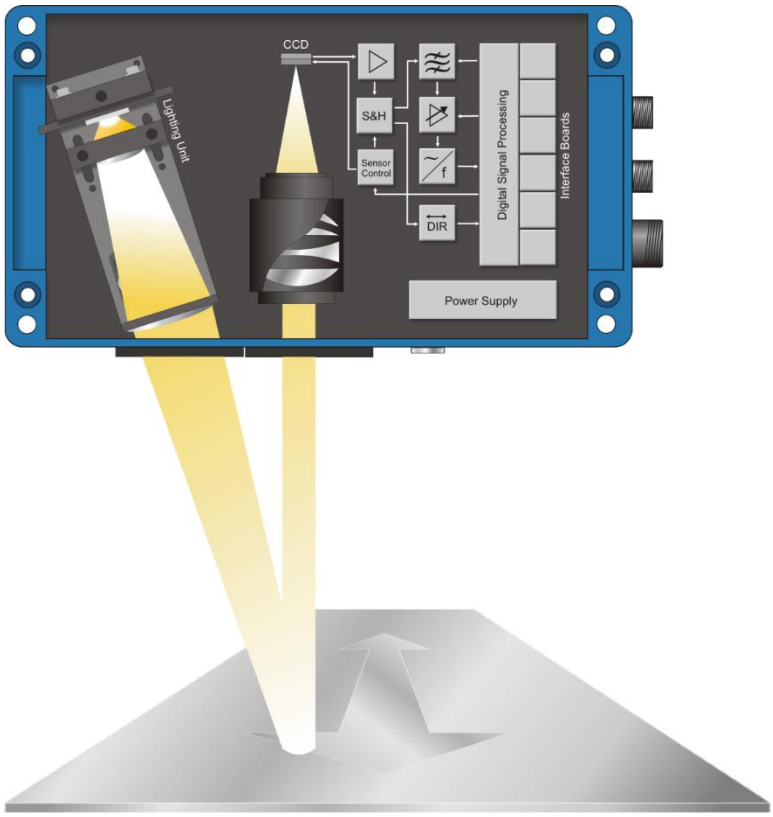


Figure 2: Simplified structure of a VLM500

The VLM500 evaluation electronics determine the frequency of the signals (bursts). It realizes a short-term frequency measurement by evaluating individual periods. The speed is calculated by multiplying the frequency with the device constant and the calibration factor. The object length can be determined by integrating the speed over time. The integration can be controlled by an external signal (trigger). Length measurements of greater than 0 m up to a maximum length of 100,000.00 m (in the meter setting) or 500,000.00 km (in the kilometer setting) are possible. Lengths under 10 m are generally saved as invalid measured values[4]. The current length values are transmitted to the CDB display at regular intervals and displayed there. A measuring rate "R" is also calculated. It can be used to optimize device assembly and monitor the measurement function.

[4] A minimum length of 10m is required to comply with the MID accuracy class.

2.4 LED-Indicators

The VLM500-MID has integrated LED to display operating states. The VLM500 has five LED in the lid, whereas the CDB has one LED in the membrane keyboard.

Table 1: Indicators of the VLM500-MID

LED	Color	Meaning
Signal LED	Green	1. Measurement signal available 2. in connection with parameter *Minrate:* good signal
	Red	1. No signal available 2. in connection with parameter *Minrate:* the threshold value not exceeded
	Orange	In connection with parameter *VMIN*: signal available, but threshold value not reached
	Off	Device off or bad device condition
Busy LED	Yellow	Command processing, also during calibration and simulation Flashes while device is in standby mode
	Off	Device off or no command processing
Error LED	Red	Flashes permanently in case of fatal errors or flashes briefly in case of critical errors
	Off	Device off or no error pending
Forward LED	Green	Direction set to forward or forward automatically detected[5] Forward means: object movement from VLM500 bottom to lid
	Off	Device off or backward direction set/detected Automatic direction recognition: off when no direction was detected
Backward LED	Green	Direction set to backward or backward automatically detected Backward means: object movement from lid to VLM500 bottom Automatic direction recognition: off when no direction was detected
	Off	Device off or forward direction set/detected
CDB LED	Green	CDB ready for operation
	Red	Error pending
	Orange	Communication with VLM500
	off	Device off or bad device condition

Signal LED

A red signal LED may have different reasons:

1. No measuring object available, measuring object outside the working range of the VLM500,
2. Measurement object does not move or is outside the velocity range,
3. Measurement object does not have sufficient structure,
4. Measuring object too bright - Sensor is permanently over exposed,
5. Windows dirty.

The output 'STATUS' is switched parallel to the signal LED. As soon as it lights green, 'STATUS' is switched on. When the signal LED is yellow, ‘STATUS’ is switched off.

[5] For option Automated Direction Recognition only

Error LED

If the red Error LED lights permanently, a technical defect has occurred. If it lights briefly or permanently during operation, parameters are wrongly set or transfer errors have occurred. In all cases, the reason should be determined and removed with a PC and the command *Error* as errors with the measurement results may occur otherwise.

The Signal LED and the Busy LED lights yellow and the Error LED red during the initialization after switching on the device or after the command *Restart*.

2.5 Software integrity and software identification

A key feature of tested software is the compliance with integrity. Integrity exists when software programs run as intended or unchanged. In order to comply with this requirement, the integrity must be checked regularly. One technical implementation is the possibility of calculating checksums with the CRC16 algorithm. The checksum is then compared with a known (reference) value. If the reference value and actual value are identical, it can be assumed that the integrity is guaranteed and that there has been no intentional or unintentional manipulation of the software.

Various checksums are calculated in the VLM500-MID. In addition to the two checksums for the software of the VLM500 and the software of the CDB, a checksum is also calculated from the legally relevant parameters of the VLM500 and from the legally relevant parameters of the CDB.

The software automatically carries out the integrity check every 60 minutes. If at least one of the checksum deviates from the reference value, the user is informed of this state with a message and the VLM500-MID is switched to the unsecured state.

If the user wants to check the software integrity, this can be done via the menu "Device information / Checksum" (see Figure 3[6]).

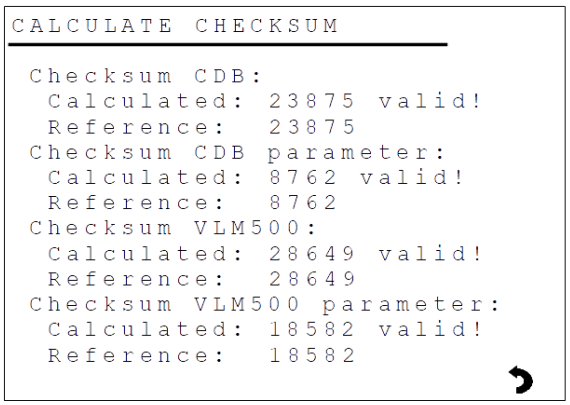


Figure 3: Checksums

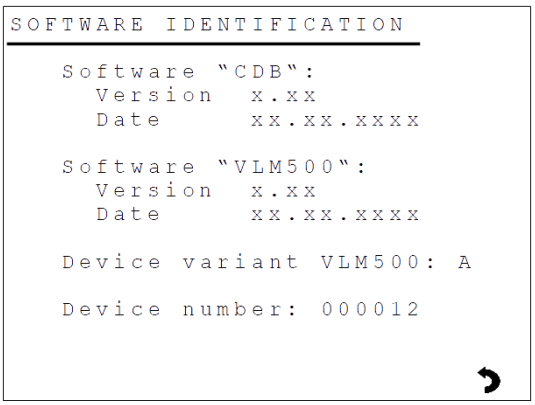


Figure 4: Software identification

A calibrated length measurement machine has a software that mustn't be changed. The installed software with its version number and its release date is therefore notified in the calibration documents. In order to check the installed version of the VLM500-MID, the software identification is shown during the switch-on procedure. By calling the menu "Device information / Software identification" the software identification can be looked up at any time (see Figure 4).

[6] The checksums shown are exemplary.

2.6 Preset length outputs

The VLM500-MID has two switching outputs for adjustable preset length. These switch when the currently measured length value is equal to or greater than a previously programmed target length. These nominal lengths (preset length) can be set via the user interface of the CDB. Both values are entered in meters. For more information how to adjust the values via the user interface refer chapter 5.7. Electrical specifications about the outputs can be read in chapter 8.3.

Preselection 1 specifies the length at which the switching output LENGTH I should switch. This switching output can be used to indicate that the actual measured value will soon be reached. For example, it can be indicated to a motor controller that a braking ramp is being driven because the movement process will soon end. Preselection 2 can be used as the actual length. If this value is reached, the switching output LENGTH II is switched through. In this way, an event can be triggered in a controller that triggers an event that automatically saves the measurement in the VLM500-MID.

The values of preselection 1 and preselection 2 can also be set and saved as parameters via the service interface.

Reaching a preset length switches the associated output. It is not a trigger event to save a measurement!

3 Operating modes

Length measurement machines that are subject to mandatory calibration[7] must be protected against manipulation. That means intentional or unintentional parameter or other changes shall be impossible. Precautions have been taken for the VLM500-MID that meet these and other requirements. When a length measurement machine is calibrated, the VLM500-MID is in ***secure mode***. The secure mode is represented by attaching seals and lead seals to both the VLM500 housing and the CDB housing (see the photo on the cover sheet of this user manual as an example). The device itself only recognizes the secure mode by the absence of a special programming adapter. The VLM500-MID software checks its own integrity at regular intervals using the calculation of checksums. If a checksum does not match the reference value, the device switches automatically into ***unsecured mode***. This mode is indicated to the user by a flashing exclamation mark framed in a circle ⓘ, which is shown in the upper area of the display.

If the programming adapter is connected to the CDB housing (see Figure 5), the VLM500-MID is always in unsecured mode. Legally relevant parameter changes can only be made with a connected programming adapter.

When the length measurement machine is calibrated, the connection flange for the programming adapter is closed with a screwable cap and then a seal is attached over it (see Figure 6). The cable connection between the main components VLM500 and CDB is also sealed (see Figure 7). This ensures that any manipulation or falsification of the software or the measurement data is impossible.

Figure 5: CDB with programming adapter

Figure 6: CDB with sealed programming connector

Figure 7: CDB with sealed screwed connector

If the device is in unsecured mode, length measurements can be carried out at any time. But the data set is marked as non-legal.

[7] For more information about the obligation to calibrate a machine consult national directives and/or laws.

4 Device models

Different device models of the VLM500 series are available, which are electrically- and connection-compatible. Most options (interface cards, assembly accessories etc.) can be used for all models. The differences in measurement range, working distance and distance variance result from the used optics and the signal processing of the devices VLM500A, VLM500D and VLM500L. All devices of the VLM500 series are suitable for highly dynamic processes (minimum update rate of 0.2ms), and have an internal length calculation.

The measuring devices must not be operated out of the velocity range specified in the data sheet, otherwise no proper functioning can be guaranteed. We kindly ask you to consider the parameter *Mode*, as it directly effects on the maximum permissible velocity. The parameter *Vmax* must be set according to the actual maximum plant velocity. A reserve of 10 % was already considered in the device.

VLM500A

The VLM500A is designed as universal device and allows measurements on very different materials. The device can automatically adapt to reflection, color and structure of the material surface in an extremely wide range.

VLM500D

The VLM500D is specifically designed for application on metallic surfaces and a large distance variance.

VLM500L

The device VLM500L is mainly used for measuring lower velocities.

VLM500E

The device VLM500E is mainly used for measuring medium velocities. It has the largest working distance.

Comparison of VLM models

Table 2: VLM500 device models

	VLM500A	VLM500D	VLM500L	VLM500E
Nominal distance and working range	**185 ± 15 mm**	**240 ± 15 mm**	**185 ± 10 mm**	**330 ± 30 mm**
Extended working range	**185 ± 15 mm**	**240 ± 30 mm**	**185 ± 15 mm**	**330 ± 30 mm**
Measuring range	**0.60 to 2200 m/min**	**0,18 to 1200 m/min**	**0.12 to 250 m/min**	**0.60 to 2000 m/min**
	(0.01 to 36 m/s)	(0.003 to 20 m/s)	(0.002 to 4.1 m/s)	(0.01 to 33 m/s)
- in extended working range[8]	**1.20 to 3000 m/min**	**0.72 to 2400 m/min**	**0.30 to 600 m/min**	**1.00 to 2700 m/min**
	(0.02 to 50 m/s)	(0.012 to 40 m/s)	(0.005 to 10 m/s)	(0.016 to 45 m/s)
- with special filter FB2V	**0.35 to 280 m/min**	**0.18 to 150 m/min**	**0.08 to 100 m/min**	**0.41 to 270 m/min**
	(0.006 to 4.6 m/s)	(0.003 to 2.5 m/s)	(0.002 to 1.6 m/s)	(0.007 to 4.5 m/s)
- in extended range and FB2V	**0.75 to 570 m/min**	**0.42 to 330 m/min**	**0.25 to 200 m/min**	**0.82 to 540 m/min**
	(0.012 to 9.5 m/s)	(0.007 to 5.5 m/s)	(0.004 to 3.3 m/s)	(0.014 to 9.0 m/s)
Measurement uncertainty DIN 1319 / ISO 3534	**±0,025 % for reference distance** (±0,05 % in working distance range and ±0,2 % in extended working range)			
Reproducibility DIN 1319 / ISO 3534	**±0,025 %**			
Material	Nearly all surfaces	Metallic surfaces	Metallic and other surfaces	Metallic and other surfaces
Application	Universal	Universal	Low velocity	Universal

[8] The extended working mode is activated by changing the parameter MODE to 1.

5 CDB Handling

5.1 Keypad

Below the CDB display there are four buttons with a raised embossing. With the help of these buttons, the user can navigate through the menu structure, select menu items and call up information about the system and the stored measured values.

The keys are designed as softkeys. This means that depending on the selected menu, the buttons have a different function. The current meaning of a key is indicated by a small icon at the bottom of the screen above the key. The following table shows the meaning of the possible symbols.

Table 3: Display symbols and there meaning

	One menu level back
	One menu entry up
	One menu entry down
	- Reset counter (in manual working mode) - Switch display between measured value details and metadata
	Print data set
	Send data set to protocol interface (PLC, PC etc.)
OK	- Enter selected menu entry - Store data set (in manual working mode)

5.2 Switch-on procedure

The CDB is supplied with power via the VLM500. The CDB is therefore switched on together with the VLM500. After switching on, the ASTECH logo is shown on the CDB display. This is followed by the display test, the integrity check of the software and the display of the software identification. The CDB also checks the internal hardware components like the memory with the measurement data. If the result of this memory test is negative, i.e. the memory is not available, a message is shown on the display. The counter is then immediately put into the unsecured mode.

To evaluate the display test, the user must look at the screen and identify any pixel errors. During the integrity check of the software, checksums are calculated and compared with reference values. All values are displayed on the screen. The software detects any differences that occur and immediately switches the VLM500-MID into unsecured mode.

If this occurs, the device can still be operated and used. However, new measured values are saved as invalid measured values. The software identification (version numbers of the software) is displayed after the checksums.

After this automatic switch-on test run, the menu *measurement display* is automatically displayed. A length measurement process can then be started right away.

To get back to the main menu (Figure 8) the softkey must be pressed.

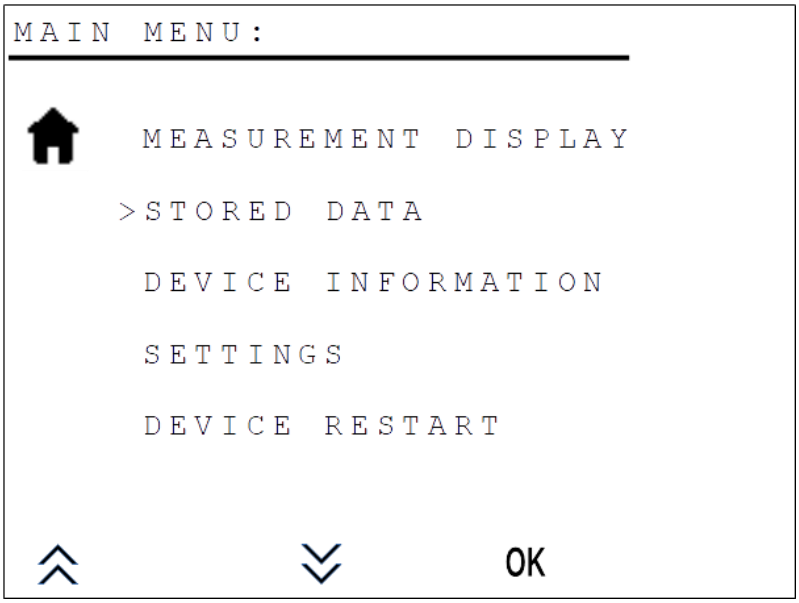


Figure 8: Main menu of CDB

5.3 Menu structure

Figure 9 shows the entire menu structure of the CDB user interface. With the help of the control buttons (, , OK and), the user navigates through the menu items and levels and calls up a function. Figure 8 shows the menu structure of the CDB user interface.

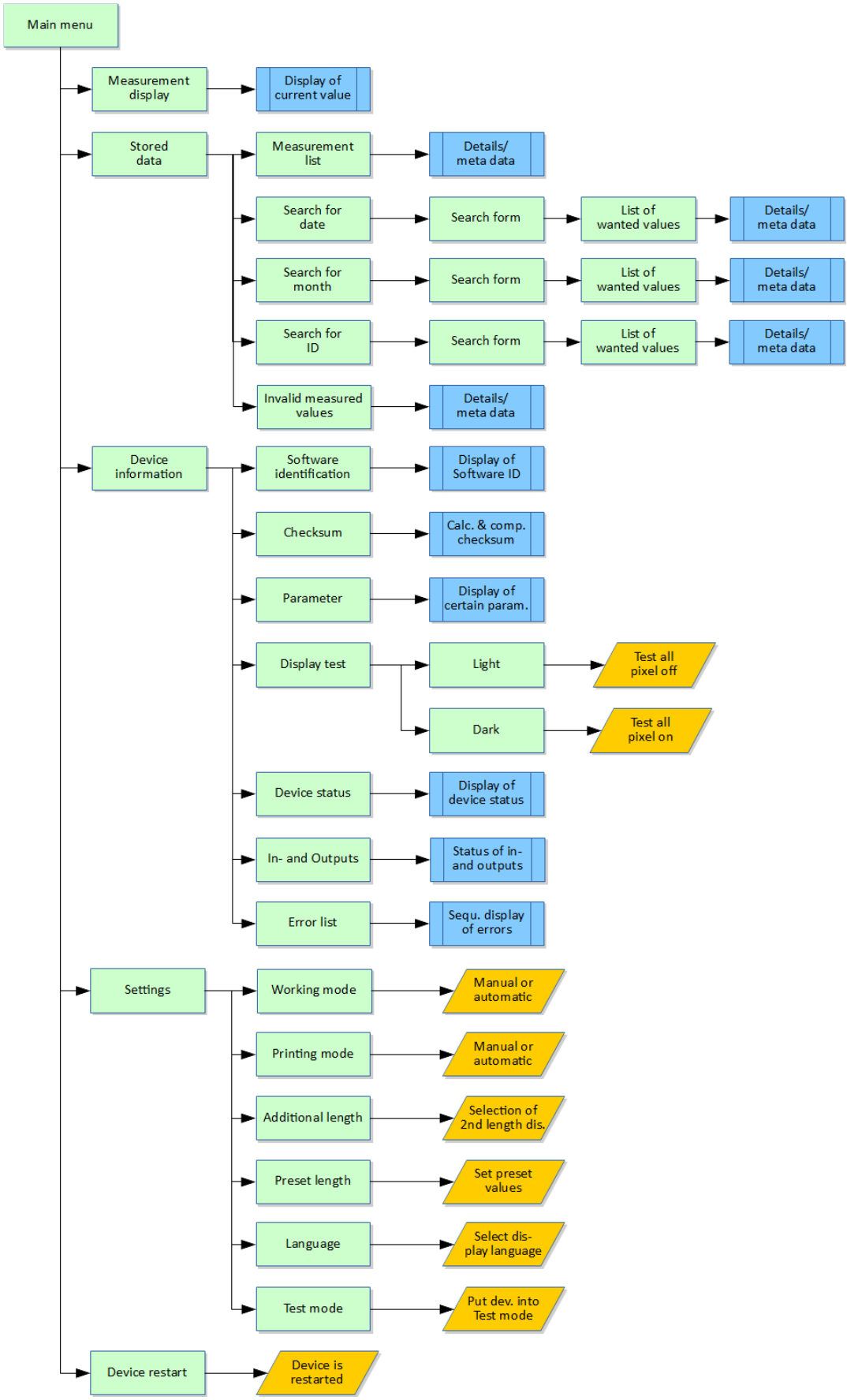


Figure 9: CDB menu structure

5.4 Measurement display

The main task of the CDB is to display the current length measurement. This function is called up via the menu item "Measured value display" or this function is called up immediately after switching on. Figure 10 shows the menu item "Measured value display". The relevant length value is shown with large characters in the middle of the display. Further information that is shown in the measurement display are:

- measuring rate (in percent)
- current speed of the measuring object (in m/s)
- display of the length in a second (alternative) unit (can be set by the user)
- working mode of the VLM500-MID
- amount of available and occupied memory
- date and time
- state of the Preset Length outputs.

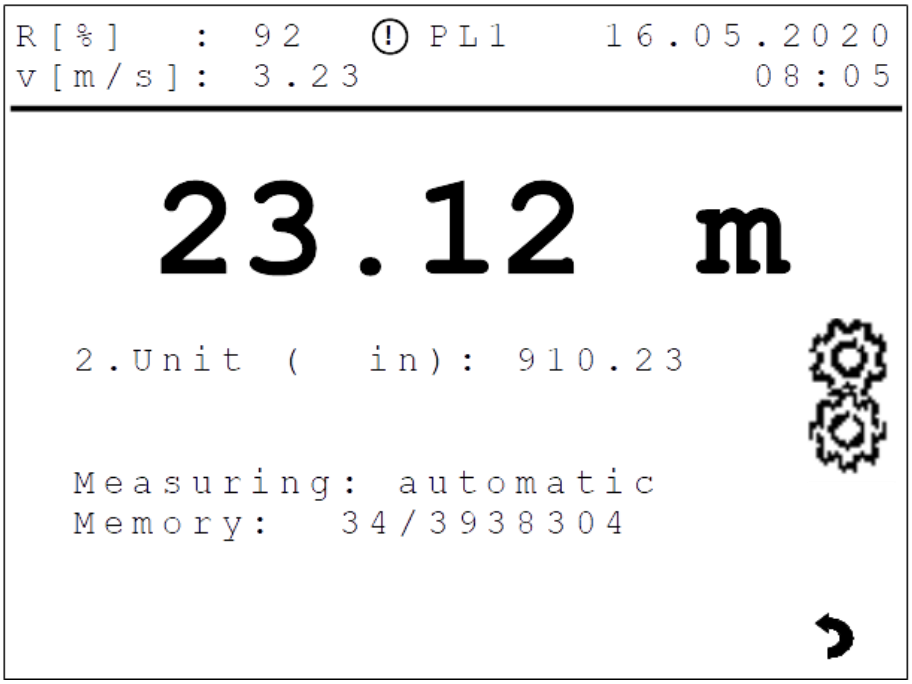


Figure 10: Menu "Display Measurement"

Further symbols that can be displayed on the screen are:

- : if the CDB is configured so that a printout is to be made manually, a printer symbol is displayed after a measurement was saved
- OK : if manual working mode is selected, this symbol indicates that a dataset can be saved[9]
- : if manual working mode is selected, the counter (length) can be reset to zero
- : if manual working mode is selected, the content of the saved dataset is transmitted to the protocol interface.

[9] For more information about the working modes refer chapter 6.

5.5 Stored data

5.5.1 Measurement list

All measured values recorded with the VLM500-MID are permanently stored in the internal device memory. To call up or view a saved dataset, the "Stored data" menu must be called up. Here there is the possibility to view all measurement data in one list, to view certain measurement data corresponding to a date or month and to view all invalid measurement data. Furthermore, by entering a measurement ID, the associated data record can be specifically called up.

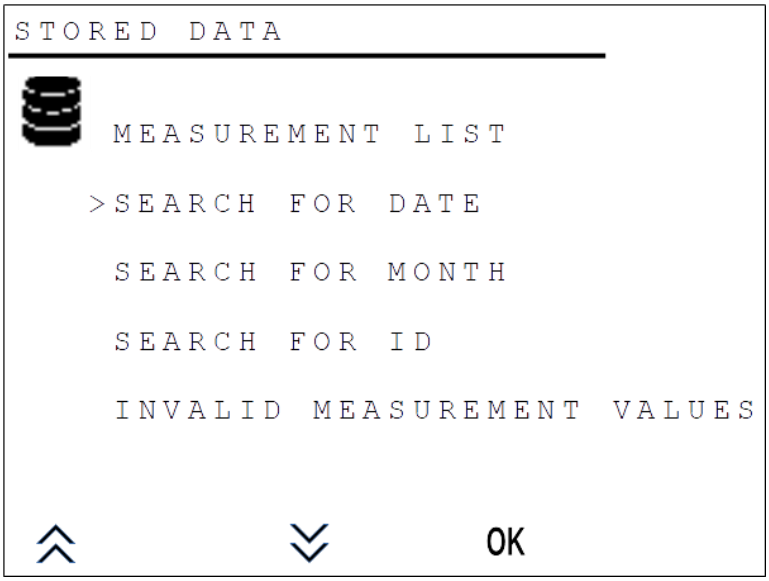


Figure 11: Menu "Stored data"

5.5.2 Storage period and memory size

The storage capacity in the VLM500-MID offers space for a total of 3,938,104 data records. If a memory location is occupied, the next free memory location is used automatically. If all storage locations are occupied and the minimum period[10] for storing the oldest data record has not been exceeded, no more datasets can be saved. If the minimum period has been exceeded, setting of the *%overwrite* command determines whether a dataset is automatically overwritten or not. If automatic overwriting is activated *(% overwrite y*), the oldest data record is always overwritten. A maximum of 99,999 datasets can be saved per day. If this limit is reached every day, the entire memory would be full after 39 days.

5.5.3 Measurement details

A list entry can be selected from the list with the arrow keys and the details of this can be called up. Figure 12 shows the measurement details. All legally relevant information of this data set is displayed in this view. In addition to the length value and its unit, this also includes a unique measurement value identification number (dataset-ID), the date and time of data recording and the device identification. A checksum is calculated and displayed when a dataset is called up. The software automatically compares the newly calculated value with the originally stored checksum and carries out a comparison. If the values match, the message "Dataset is valid!" is displayed. If the checksums do not match “Data record is invalid!” is displayed. Furthermore, this dataset is marked as an invalid dataset. A dataset that has been marked as invalid once cannot be marked as valid again.

[10] The default minimum storage period is 90 days. Can be changed with the command *%duration*.

If user likes to have a printout of the dataset, the corresponding printer button needs to be pressed one time. To share the data set with a PLC, PC, Server, the - button must be pressed on time. The meta data (e.g. article number/name, machine name) of a dataset can be showed by pressing the - button.

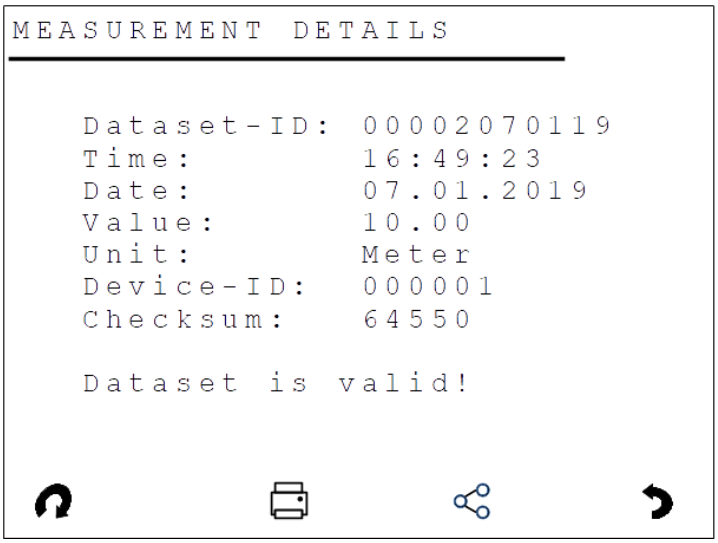


Figure 12: Details of a saved data set

5.5.4 Searching for specific measurement data

In order to avoid a time-consuming search for specific measurement data, an exact date or a specific month of a year or a specific measurement ID can be specified in a search mask. This means that only the data records that match the search criterion are displayed.

Search for date

Figure 13 shows the search mask for searching for an exact date. The user must specify a specific date. The OK button is used to jump between the three dates, year, month and day. Use the arrow keys to set the desired date value. The search is started by pressing the - key. Now a filtered measurement list is showed on the screen which can be operated like the normal measurement list.

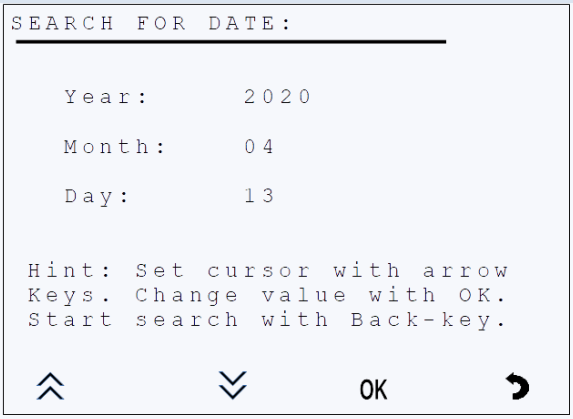


Figure 13: Mask to search for a specific date

Search for month

To search for data for a specific month, the user must specify the year and the month must then be entered here. The OK button is used to jump between the year and the month. The arrow keys are used to set the desired date value. The search is started by pressing the - key. Now a filtered measurement list is

showed on the screen which can be operated like the normal measurement list. Only datasets corresponding to the specified month and year are included in the filtered list.

Search for ID

If a specific dataset is to be looked up and the dataset identification number is known, the number can be entered into the search mask shown in XXXXX. The arrow keys are used to move the cursor. With OK the digit can be changed. The search is started by pressing the ↩ - key.

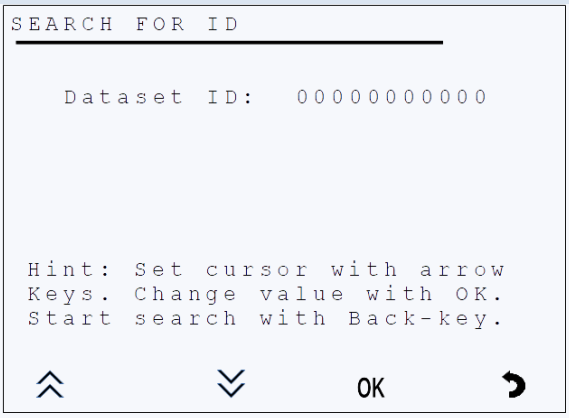


Figure 14: Mask to search for a specific dataset

5.5.5 Invalid measured values

If a saved dataset was defined as invalid by the software, it is copied in the list of invalid measured values. There can be three reasons for an invalid dataset. First, the VLM500-MID was in unsecured mode while the dataset was saved. Second, the measured length was shorter[11] than 10 m while the dataset was saved. Third, the test of the checksum, while selecting a dataset from the list, failed.

The list with the invalid measured values shows only such dataset. The structure is the same as the list of the stored measured values. However, all invalid measured values are also part of the normal measurement list.

5.6 Device information

The user can look up various information about the system and run the display test. The following table presents the available information levels.

Software identification

Shows the software version and the release date of the installed software. Both, VLM500 and CDB have a separate software.

This information is relevant for a calibrated machine.

Checksum

Shows the calculated checksum and the corresponding reference value of each software part. Each time this information menu is called up, the checksums are recalculated. If the comparison with the reference value fails, the system is put into the unsecured mode.

[11] To comply with the accuracy requirements, a minimum length of 10 m is necessary.

Parameter

Shows the setting of selected parameters from the CDB and the VLM500.

Display test

The display can be tested during operation. It is called up via the menu item "Device information / display test / light or dark". During the display test, all display pixels are switched off or on for 2 seconds each. This enables the user to check whether there are defective pixels. If one or more pixels are defective, the user has to decide whether the defect means that it is no longer possible to correctly read the stored measured values. The manufacturer must then replace the display. However, this leads to the length measurement machine losing its calibrated condition!

Device status

Shows the current and highest internal temperature of the CDB. This information can be relevant in case of a system malfunction.

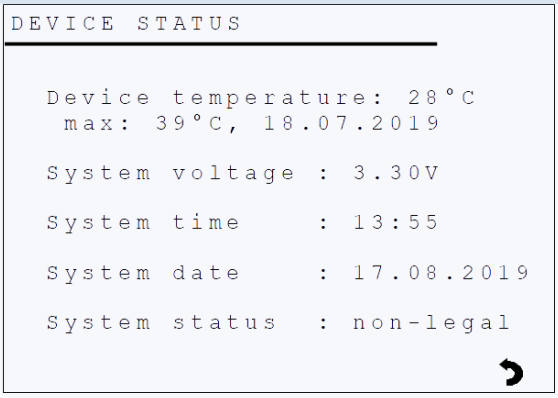


Figure 15: CDB Status page

In- and outputs

Shows the logic condition of all CDB in- and outputs. This information can be used to check the voltage levels of external connected signals.

Error list

Shows all current pending error of the VLM500-MID system

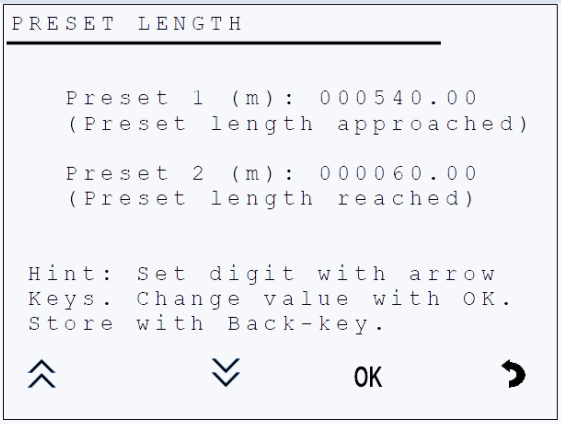
5.7 Settings

The behavior of the CDB can be adjusted by using the settings menu. The following table lists the available options.

Working mode
The working mode sets the way a measurement is done with the VLM500-MID. The available options are: - manual sequence - triggered sequence. *Manual sequence* means the length measurement is done (saving) manually by pressing a keypad button. *Triggered sequence* means the length measurement is triggered and saved with an external signal. For more information refer chapter 6.
Printing mode
The printing mode set if a label is printed out each time a measurement was saved. The available options are: - manual - automatic. *Manual* means that after a saved measurement, the printer button needs to be pressed to get a printed label. *Automatic* means that the label is printed automatically each time a measurement is saved.
Additional length
Additional length sets the unit of the second length indication shown in the measurement display. The length indication has no legally relevance. The available options are: - none - meter - kilometer - inch - feet.

Preset length

Preset length sets the two lengths at which the associated outputs switch. For detailed information about the preset length outputs refer chapter 2.6. The value is adjusted by selecting the digit with the arrow keys, changing the digit with the OK-button and saving the values with the back - key. The maximum value can be 99,999.99 m.



Language

Language set the CDB user interface to the selected language. The available options are:

- German
- English.

Test mode

Activating the *Test mode* turns the VLM500-MID into a special operation mode. It used to change any parameter of the VLM500 for testing purposes without the need of the programming adapter. Changed parameters cannot be saved!

To test parameter changed while the VLM500-MID is in secured mode, the *Test mode* can be used for that.

Testing parameter changed can be necessary if the measurement object changes.

Delete Data

This menu entry is only available when the VLM500-MID is in unsecured mode when the programming adapter is applied to the CDB.

With *Delete data* it is possible to delete all datasets stored in the CDB.

Care should be taken calling this function because all datasets will be deleted irrevocably.

6 Performing a measurement process

Depending on the material to be measured or depending on the length measurement machine, different ways of performing the measurement process exist. The VLM500-MID offer two different operation modes. For length measurement tasks that take place automatically and without the intervention of an operator, the "triggered sequence" should be selected in the VLM500-MID. For other cases where cutting to length is done by hand, the "manual sequence" should be selected. The working mode is set via the menu item "Settings / Working mode" (see chapter 5.7).

Triggered sequence

If a length measurement with the VLM500-MID is to be carried out with external trigger signals, the measuring device must be supplied with a switching signal. As shown in Figure 16, the trigger signal is connected to the trigger input of the CDB.[12]

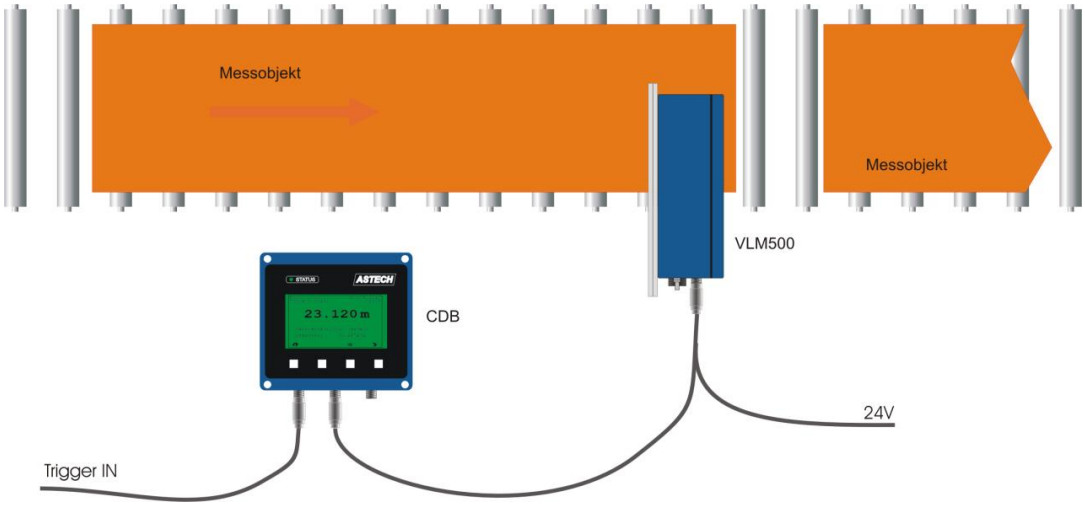


Figure 16: Principle structure of a triggered length measurement

VLM500 parameter TRIGGER

Depending on how the (legally relevant) VLM500 parameter "Trigger" is set, a length measurement is level-triggered or edge-triggered.

Level triggered (see Figure 17): If the level of the trigger signal changes from LOW to HIGH, a new length measurement begins. As long as the level is HIGH, length integration takes place and the updated measured value is continuously displayed. If the level changes from HIGH to LOW, the length measurement is ended.

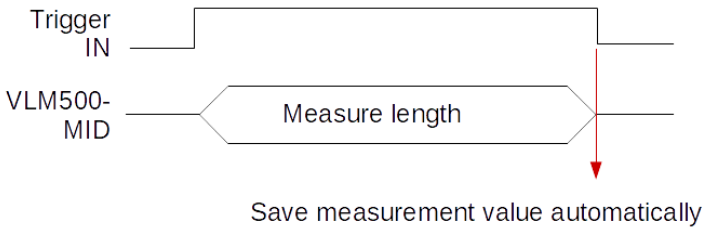


Figure 17: Timing diagram of a level-triggered length measurement

[12] Triggering via a software-signal is also possible. Refer chapter 8.6.

Edge triggered (see Figure 18): With each edge change (H/L or L/H) of the trigger signal, a new length measurement begins and ends. The current length value is displayed continuously.

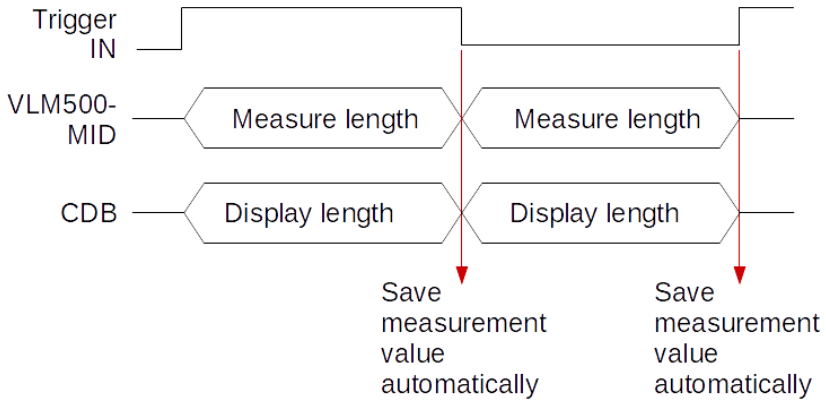


Figure 18: Timing diagram of an edge-triggered length measurement

In any case, in trigger mode, when a trigger event occurs, the length value with additional information is automatically stored as a data record in the memory. It is not possible to interrupt the length measurement via the user interface in this mode.

In addition, the generated data record is transferred to the optional data output interface. If a PC/PLC is connected to this interface, this data record can be used for external data storage purposes. The data record output via the data interface is not legally relevant. The legally relevant data record is permanently stored in the CDB.

Every time a data set is saved, the software checks the success of the saving process. If the result of this test is negative, i.e. the data record could not be saved, an error message is shown on the display. The counter is then set to the unsecured mode.

Manual sequence

In the case of a manual measuring sequence, it is assumed that there is no trigger signal and that the length measuring machine is operated. The user is able to reset the counter (length value) before starting a measurement. After the length measurement has been completed, the measured value must be confirmed by pressing the OK button. The length value is then automatically saved as a data record with the associated status information (time, date, length unit). The measurement display shows additional symbols on the screen and more buttons can be used.

It is possible to reset the length counter back to 0 by pressing the ↶ - key. The measured value is confirmed and thus saved and transferred to the data output interface by pressing the OK - key.

The 🖨 - symbol appears after the OK - key was pressed. By pressing the 🖨 - key, the last data record is sent to the printer. The same data record can be printed out several times. If automatic printout is turned on, the printer symbol is then hidden and the associated key has no function.

7 Assembly

7.1 VLM500

The assembly is done transversally to the direction of movement of the measuring object (see drawing in the annex chapter 14.6). The standard direction of movement (forward) is determined as from housing bottom to housing lid. The movement direction is marked by an arrow on the device (plus means forward).

> The assembly can be made in positive and in negative direction. Only the parameter *Direction* must be set accordingly (see programming)! Also, in case of an automatic direction detection *Direction* must be set.

It is not necessary to open the device for assembly. The VLM500 is fastened with four M6 hexagon socket bolts.

The working distance stated by the manufacturer (the distance between the lens window to material surface) and workspace must be strictly observed (see type sign at the VLM500).

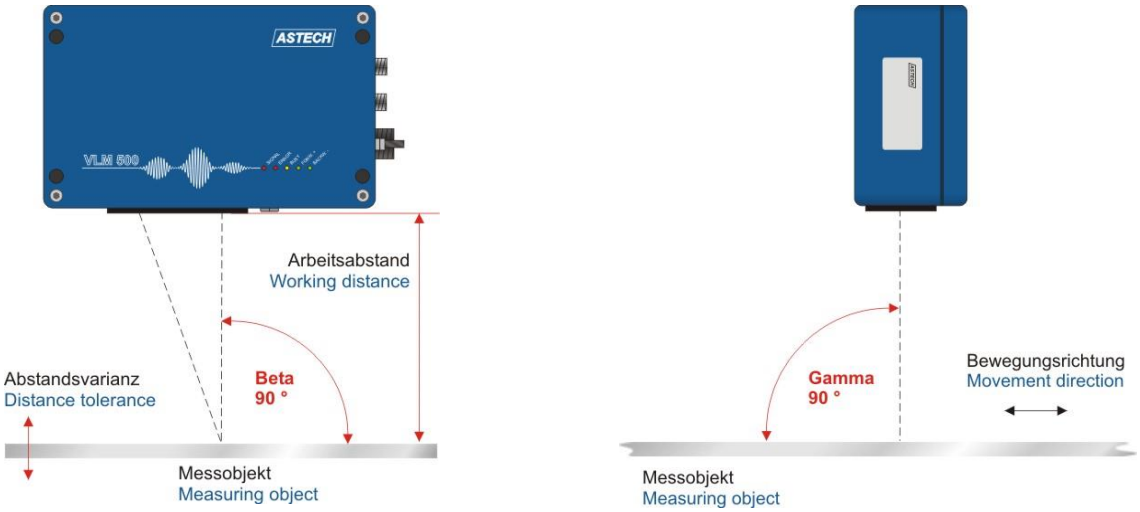
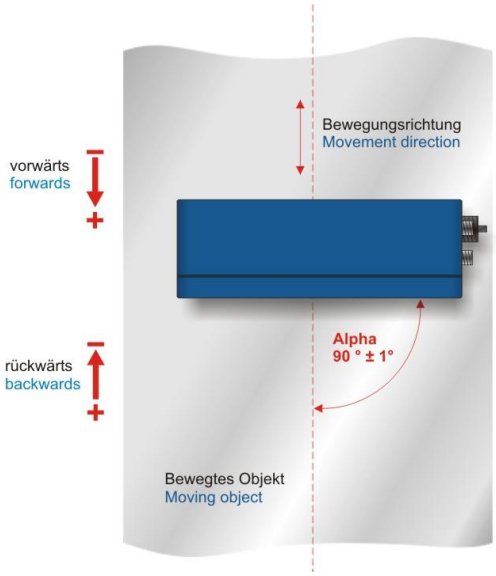


Figure 19: Working distance and alignment towards the measurement object surface



Angular orientation Alpha with maximum tolerance of ± 1°.

Figure 20: Alignment towards the velocity vector

The assembly is made rectangular from the material's direction of movement with a maximum tolerance of ±1°. If the alignment is not made with the stated tolerance, measuring errors may occur.

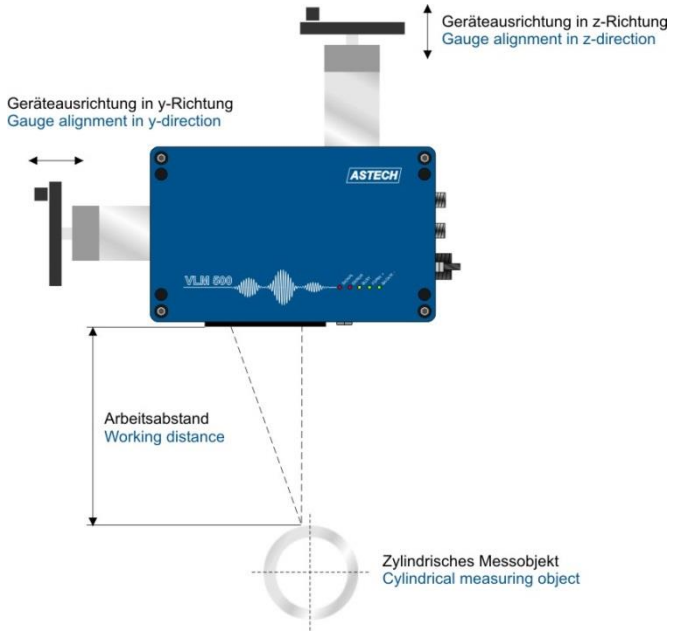


Figure 21: VLM500 with linear unit LJ2

Optional linear units also allow an adjustment in case of changing material distances (LJ1 for one axis) or for round surfaces as e.g. pipes, wires and profiles (LJ2 for two axes).

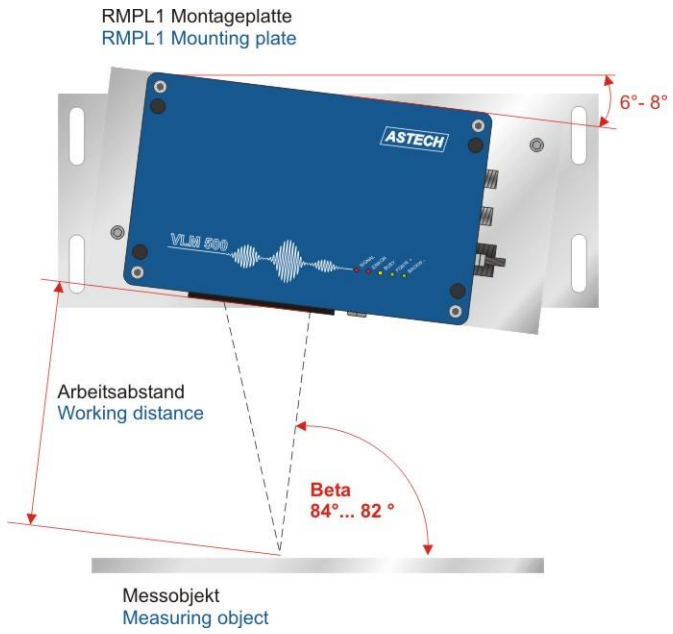


Figure 22: VLM500 with mounting plate RMPL1

A tilt around angle Beta is possible if the mounting plate RPL1 is used. No measurement error occurs from this. The tilt is needed for measurements on highly-reflective materials and some plastic surfaces.

An optimization of the alignment in case of reflecting or convex surfaces can be done after the device is powered up and the programming cable is connected. With the VLM500 command *TestQuality* the user should align the VLM500 to get a maximum measurement rate in the movement or 2/3 of the maximum value during standstill.

7.2 CDB

The housing of the CDB has four holes in the bottom of the housing through which the CDB can be attached. The cover does not have to be removed because the holes are also present in the cover. The drilling pattern can be looked up in section 14.6.

The CDB is operated in combination with a VLM500. The connection cable between the two modules has a maximum length of 10m. The CDB must be installed within this area in such a way that operation and reading of the display are possible without any problems.

The CDB can be equipped with a suitable swiveling and tilting device holder and a corresponding mounting plate.

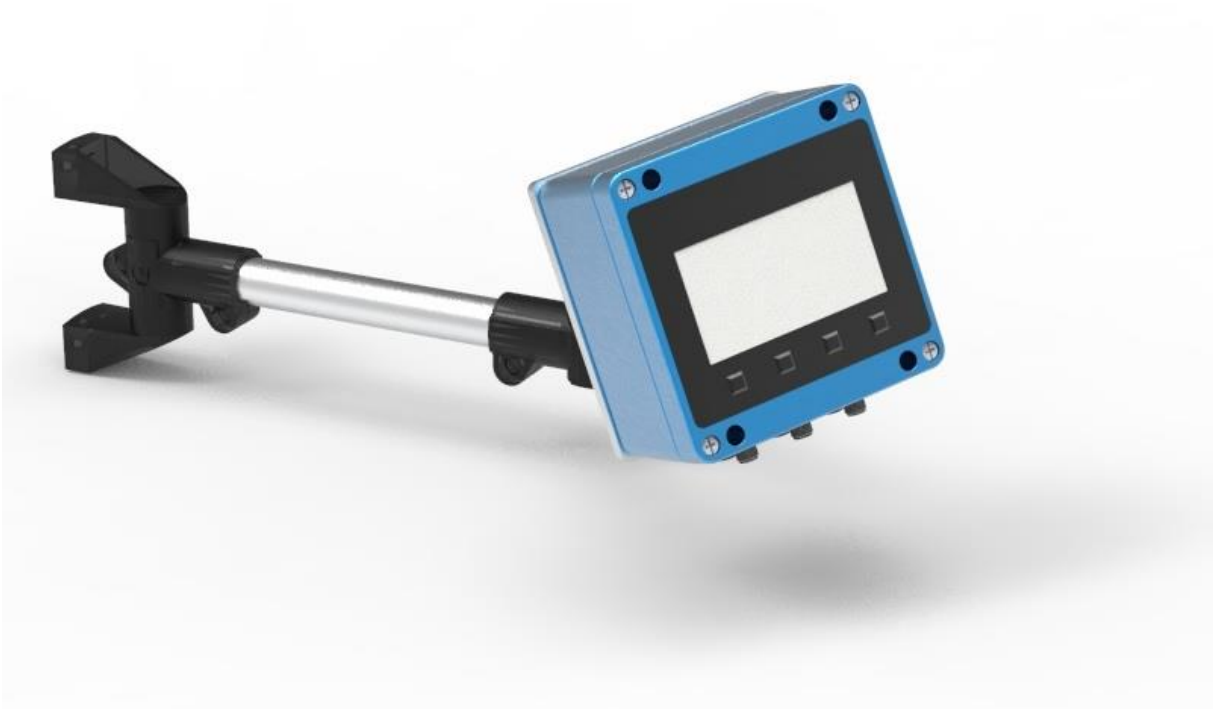


Figure 23: CDB with swiveling and tilting device holder

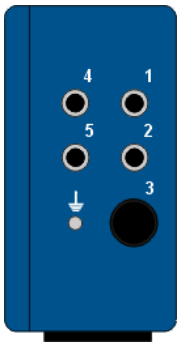
8 Connections and Interfaces

8.1 General

Both device components (VLM500 und CDB) have screwable connections. Figure 24 and Figure 25 show the available connections of the VLM500 and the CDB respectively.

> ⚠ Plug connectors must not be plugged in or disconnected when under voltage. All connection works must be carried out in dead-voltage state!

connector 4: Pulses (optional)
connector 5: Field bus (optional)
Grounding screw



connector 1: Analog output (optional)
connector 2: Connection to CDB
connector 3: Power supply

Figure 24: VLM500 device connections

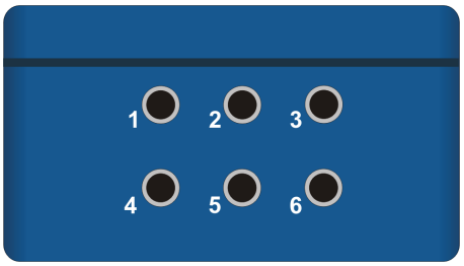


Figure 25: CDB device connections

connector 1: Connection to VLM500
connector 2: Programming adapter (Dongle)
connector 3: Service
connector 4: In- and outputs
connector 5: Data output (Field bus)
connector 6: Printer

The pin assignments of the device connections can be found in the appendix (chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**).

Shielded plugs and cables must always be used for the transmission of signals. The cable for the parameterization (device connection 3, CDB) must be removed after programming. The shielding must always be earthed. Plugs and cables can be obtained from the manufacturer.

The device connections 1, 4 and 5 on the VLM500 are optional and are only equipped with a flange if an additional output interface (pulses, analog, process data) has been purchased with the VLM500-MID[13].

> ⚠ Device connections that are not connected are to be protected against the ingress of dirt by means of blind plugs.

[13] It is possible to retrofit the device with additional output interfaces.

8.2 Power supply and grounding

The VLM500-MID operates with a 24 V DC power supply (20 to 30 V). The supply takes place via device connection 3 on the VLM500. The CDB is power supplied from the VLM500 via the VLM500/CDB connection cable.

A power cable with a loose end is included in the scope of delivery. All terminals in the connection plugs (except DSUB9 on the programming cable) can be screwed. It is the responsibility of the user to establish the cabling in accordance with the applicable regulations. Before the device is connected to the power supply, a connection must be made between the grounding screw on the VLM500 and the device holder using the grounding cable supplied. The device holder must also be grounded with low resistance! The pin assignments of connector 3 can be found in the appendix.

A missing or insufficient grounding of the measuring device may result into malfunctions or damages of the electronic assembly in case of overvoltages!

8.3 Switching in- and outputs

The VLM500-MID has two switching inputs (trigger, direction) and four switching outputs (error, status, length I, length II). The connections are galvanically (optocoupler) separated from the CDB. Care must be taken that the potential differences between the output and input signals to protective earth (PE) are less than 42 volts. The pin assignments of connector 4 can be found in the appendix.

The protective circuits integrated on the connection and interface cards respond to voltage differences> 42 volts between the signals or the protective conductor. Discharging the overvoltage can trigger the protective circuit and thus brief failure of the relevant signal!

Outputs

The outputs are implemented as transistor outputs with a common collector connection. The positive connection is supplied with an external voltage in the range of 10 V to 30 V. A load against ground of the external power supply is connected to the negative connection of the output. The maximum output load is 30 mA for each output. In case of a typical external voltage of 24 V and a load current of 20 mA, a load resistance of 1.2 kOhm must be used. See Figure 26: wiring example for the CDB outputsFigure 26. The load can also be an optocoupler on the user side.

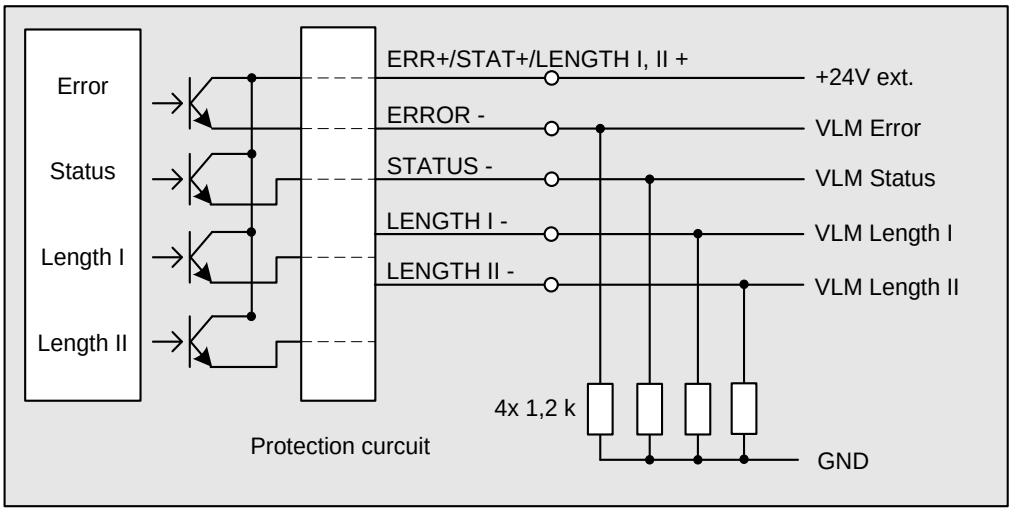


Figure 26: wiring example for the CDB outputs

Inputs

The inputs have a common ground connection. An input input voltage of +10V ≤ U_{in} ≤ +30V corresponds to a HIGH level (I_{in} maximum 15mA) and an input voltage < +8 (I_{in} maximum 9mA) corresponds to a LOW level.

The input for the direction signal Direction can be HIGH- or LOW active. The programming takes place over the command *Direction*.

The trigger input serves to control the length calculation. It is programmed through the parameter *Trigger* (HIGH- or LOW level or edge) and realizes the Start or Stop of the device internal length integration.

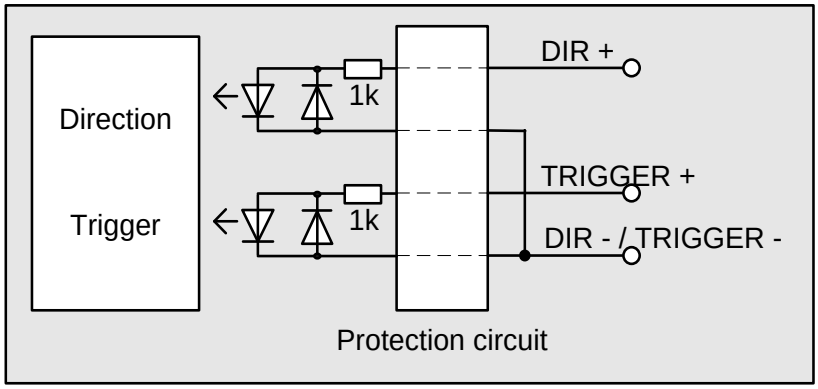


Figure 27: wiring example of the CDB inputs

The maximum input frequency must not be exceeded 500 Hz. The duty cycle must hereby be 1:1. The input signal must be absolutely bounce-free. The use of relay contacts is not allowed!

8.4 Service interface USB

The parameterization interface in the VLM500-MID is designed as a galvanically isolated USB interface. With the aid of a Windows PC and the VLMTool, device settings can be made and data can be recorded for service purposes. The USB signals '5V', 'D-', 'D +' and 'GND' are used. The USB interface is an internal RS-232 interface (virtual COM port) that is converted to USB using a integrated circuit from FTDI. The standard baud rate is *115200*.

Installation of USB drivers

An integrated circuit (FT230X) from Future Technology Devices International (FTDI) is part of the CDB to implement a USB connection. This provides a virtual serial interface on the PC side. This allows communication with the VLM500-MID in the same way as if it had an RS-232 interface. To ensure this functionality, a driver must be installed on a Windows PC. This driver is located on the USB bar that is included in the scope of delivery. It can also be downloaded from the ASTECH website.

Windows must be fully started for the driver to be installed. The "IUSB_driver_FTDI.zip" file must be extracted to a known location on a hard drive. Then the VLM500-MID is connected to the PC. It is advisable to first connect the end of the cable to the CDB and then the other end of the cable to the PC. Windows should now have recognized the new hardware and search for a driver. The manual driver installation must now be selected and the path entered into which the contents of the ZIP file were previously extracted. After the installation, the entry "USB Serial Converter" should appear in the Windows device manager. Windows then recognizes another hardware component, the “USB Serial Port”. Again, manual driver installation must be selected and the path specified in which the contents of the ZIP file were previously extracted. When the installation is complete, a new COM port will appear in the Connections tab of the Device Manager. This COM port must be selected later when using the VLMTool for communication.

Note: The VLM500-MID does not have to be switched on to install the driver. The FT230X is supplied with power by the PC and thus enables the driver to be installed.

If the VLMTool is installed, the user is automatically offered to install the USB driver as well. For this it is recommended not to connect the VLM to the PC. The device should only be connected to the PC after the VLMTool and the driver have been fully installed.

8.5 Printer connection

A serial printer with an RS-232 interface can be connected to the VLM500-MID to create a printed label of the length measurement that has been carried out. The pin assignments of connector 6 can be found in the appendix.

The VLM500-MID uses the ESC / POS® transmission protocol developed by Seiko EPSON. These are standardized commands (so-called escape sequences) that are sent serially to the printer. The VLM500-MID was tested with a Brother TD-4000 printer. ASTECH recommends using this printer.

The following information can be found on the printout:

1. Measurement ID
2. Date and time
3. Device ID
4. Signature of the correctness of the printed measurement values (checksum)
5. Length
6. Unit of measurement
7. Checksum
8. Reference to the legal provisions
9. Meta data (company name, machine, article number etc.)
10. The entire data set is coded as a QR code.

The correct label paper (Brother RD-S01E2, white, 44.3m x 102mm) can be obtained for the TD-4000 from ASTECH GmbH.

8.6 Protocol output (not legally relevant, optional)

All length measurements made with the VLM500-MID are stored in the non-volatile memory of the CDB. In addition, each length (together with status information) is output via the optional non-legally relevant protocol output interface to a PC or a PLC or other data processing unit. Different communication interfaces for this data output are available:

- Digital serial: USB, RS-232, RS-422/485,
- Field bus: Profinet IO, EtherNet/IP and
- Ethernet.

The interface is built into the CDB upon delivery. The flange at connection 5 has a different pin assignment depending on the selected interface. The pin assignments can be found in the appendix.

For a working communication with the protocol data output the CDB parameter *SO4INTERFACE* must be set according to the selected interface. Fixed communication parameters are: 8 data bits, 1 stop bit, no parity and

XON/XOFF flow control. With SO4INTERFACE the communication baud rate can be selected. For USB, RS-232 or RS-422/485 the value is free. For Profinet IO, EtherNet/IP or Ethernet the baud rate is fixed to 57600.[14]

Further information about the different interfaces can be read in the following chapters.

Data output

The following information is transmitted for all interfaces:

1. Date and time
2. Measurement-ID
3. Length
4. Length unit
5. Device-ID
6. Error number
7. Checksum
8. Meta data (company name, machine, article number etc.)

Meta data

To increase the practical benefit in terms of data management and data logging, metadata can be input to the CDB. This input is also made via the protocol interface. The information is transferred to the CDB via the PLC. This metadata is then stored in the non-volatile memory of the CDB and is transmitted together with the other data back to the PC/PLC.

There are five data fields for meta data available, each with a length of 20 characters. The user can fill these fields with numbers and / or characters as required. The ASCII character space is permitted except whitespaces.

There are five related commands to change the data fields:

%BARTICLE1, % BARTICLE 2, % BARTICLE 3, %BCOMPANY and %BMACHINE.

For example, if meta data “article 1” is to be changed to “GGH12345-67”, the call must be: “%barticle1 GGH12345-67”. For more information about commands and parameters, refer chapter 12.

These commands can only be called via the data output interface. Calling a command changes the corresponding meta data only temporarily. When the device is turned off, the data is lost.

If a serial interface or the Ethernet interface is used, a metadata command must be called directly as described above. If a fieldbus is used, the metadata commands are called indirectly via the fieldbus interface. The task of the user is to set up the corresponding data fields on the fieldbus level and to fill them with the corresponding data.

Trigger signal to control the length measurement

Triggering a length measurement via software is possible. A hardware signal is not necessary. If the interface is USB, RS-XXX or Ethernet the CDB command *%BTRIGGER* can be used for this. Sending *%BTRIGGER 1* starts the length measurement whereas *%BTRIGGER 0* stops it. This command can only be called via the data output interface. If the interface is a fieldbus, a bit in the control byte must be set. Refer to the chapters 8.6.2 and 8.6.3 for more information about the control byte.

[14] When choosing an Ethernet based interface, a third-party module is built into the CDB. The fixed communication parameters and the baud rate refer to the internal communication between the CPU and the third-party module.

Suppress label print out

If the CDB parameter *%PRINTDOC* is set to "A" (auto), a label is automatically printed for each completed measurement. In certain situations, this printout is not wanted, e.g. test measurements, adjustment or set-up processes. To prevent from a printout temporarily, a command can send or the control byte can used.

If the interface is USB, RS-XXX or Ethernet the CDB command *%BPRINTDOC* can be used for this. Sending *%BPRINTDOC 1* suppresses the label print out whereas *%BPRINTDOC 0* allows it. This command can only be called via the data output interface. Calling a command changes the behavior temporarily. When the device is turned off, the information is lost. If the interface is a fieldbus, a bit in the control byte must be set. Refer to the chapters 8.6.2 and 8.6.3 for more information about the control byte.

8.6.1 Serial interface

Data output

The output of the data to a serial interface is ASCII-coded. The individual values are separated from one another by a semicolon (CSV). The transmission is concluded with a carriage return (CR, 0x0D).

RS-232- interface

This interface (interface board I232) provides a serial interface according to RS-232 standard. The interface allows full duplex operation, i.e. the participant can send and receive data from other participants at the same time. Only the optically isolated signals TxD, RxD and GND are used. The data transmission is controlled via the XON/XOFF protocol (software handshake), i.e. if the receiver is not ready to receive it sends the signal XOFF to the sender that, thereupon, interrupts the sending. As soon as the receiver is ready again, it sends the XON signal. Thereupon, the sender continues the transmission.

Physical transmission parameters RS-232

Maximum wire length	15 m (30 m with low-capacity special cable)
Maximum sending level	±15 V
Minimum sending level	±5 V
Minimum reception level	±3 V
Load resistance	3 to 7 kOhm
Load capacity	≥ 2500 pF

RS-422- interface

This interface (interface board I4U4) serves for serial data transmission over larger distances. The interface allows full duplex operation, i.e. a participant can send and receive data from a second participant at the same time. Ten recipients maximum can be connected to a sender. The serial data are transferred as voltage difference between the two wires of a cable.

Physical transmission parameter:

Maximum wire length	1200 m depending on cable and transmission rate
Maximum sending level	±5 V
Minimum sending level	±2 V
Minimum reception level	±200 mV
Load resistance	1x 120 Ohm at the end of the wire (recipient termination)

RS-485- interface

This interface (interface board I4U2) serves for serial data transmission over longer distances. The interface allows only half duplex operation, i.e. only one participant each can send. 32 participants maximum can be connected. The serial data are transferred as voltage difference between the two wires of a cable.

Physical transfer parameter RS-485:

Maximum wire length	1200 m depending on cable and transmission rate
Maximum sending level	±5 V
Minimum sending level	±1,5 V
Minimum reception level	±200 mV
Load resistance RS-485	120 Ohm each on both ends of the wire (termination) and a „receiver-open-circuit-fail-save" circuit

USB- interface

The data output can also be realized using a USB interface (interface board IUSB). The interface allows full duplex operation, i.e. a participant can send and receive data from a second participant at the same time. For more information about the driver installation please refer to chapter 8.4.

The USB interface for data output (protocol) is not the service USB interface. If the user purchases a USB interface for data output, there are consequently two USB interfaces in the CDB device!

8.6.2 Profinet IO

The IFPN interface card connects the CDB to Profinet networks. This enables communication between evaluation units and the device over large distances using standardized network components. The connection is made via a round connector M12, 4-pin, D-coded, Binder series 715. A GSDML file is provided and can be installed on the PLC side.

The IFPN provides a webserver with a webpage (IP address of VLM500-MID, port 80) with information about the device and the last transmitted data set. See Figure 28.

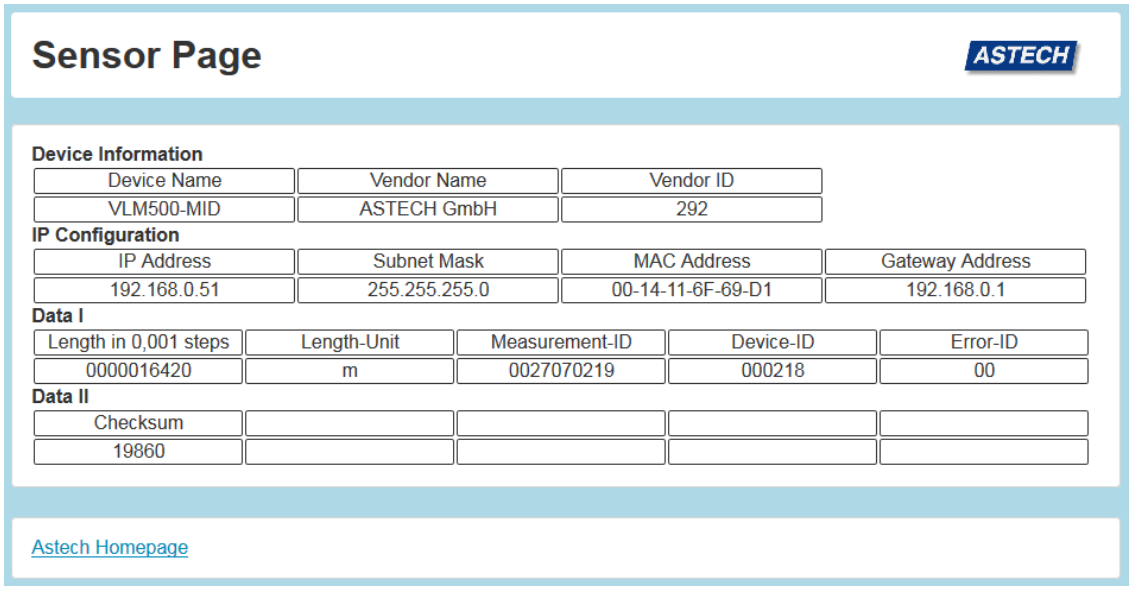


Figure 28: CDB Profinet sensor page

Configuration

The IFPN is configured using the Profinet IO controller. Interface-specific parameters such as the IP address to be used, the subnet mask, the gateway, the name or the mode can be changed.

Data output

The data output from the CDB (slave) to a Profinet master takes place synchronously with the storage of a data record in the CDB and has the structure shown in Table 4.

Table 4: Data output structure

Value	Size
Counter (life cycle counter)	2 Byte
Day	2 Byte
Month	2 Byte
Year	2 Byte
Hour	2 Byte
Minute	2 Byte
Second	2 Byte
Measurement-ID part 1 (day counter)	4 Byte
Measurement-ID part 2 (day coding)	4 Byte
Length	4 Byte
Length unit	1 Byte
Device-ID	4 Byte
Error number	2 Byte
Checksum	4 Byte
Company name	20 Byte
Machine number	20 Byte
Article number 1	20 Byte
Article number 2	20 Byte
Article number 3	20 Byte

Data input

An input data structure is available for entering the metadata like company name, machine number and article numbers 1 to 3 as well as for setting the control byte. The structure is as follows:

Value	Size
Company name	20 Byte
Machine number	20 Byte
Article number 1	20 Byte
Article number 2	20 Byte
Article number 3	20 Byte
Control byte	1 Byte

Control byte

With the help of the control byte, selected functions of the CDB can be set.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Trigger	Label print

Bit 0 is used to temporarily suppress a label printout. If the bit is set to the value "1", there is no label printout. If the bit is “0”, a label is printed out. This is only relevant, when the parameter *%PRINTDOC* is set to “A”.

A length measurement can be controlled (triggered) with bit 1. The mode of action depends on the setting of the VLM500 parameter *TRIGGER*. The following table shows how a length measurement is controlled.

Trigger	Bit 1 = 0	Bit 1 = 1
0, 1	Stop	Start
2, 3	<nothing>	Stop/Start

8.6.3 EtherNet/IP

The interface card EtherNet/IP (IFEI) connects the CDB with an EtherNet/IP fieldbus. This enables communication between evaluation units and the CDB over long distances using standardized network components.

The IFEI provides a webserver with a webpage (IP address of VLM500-MID, port 80) with information about the device and the last transmitted data set. See Figure 28. An EDS file is provided and can be installed on the PLC side.

Configuration

The IFEI interface is configured via the Ethernet/IP scanner (master). Interface-specific parameters such as the IP address to be used, the subnet mask and the gateway can be changed. The CDB receives its settings by default via DHCP. If no DHCP is available, the IP address 192.168.0.51 applies to the CDB.

Data output

The data output from the CDB (slave) to an EtherNet/IP scanner (master) takes place synchronously with the saving of a data record in the CDB and has the output data structure shown in Table 4.

Data input

The data input is completely the same as with the Profinet interface. Refer section “Data input” in chapter 8.6.2.

8.6.4 Ethernet

The FastEthernet (IFFE) interface card connects the CDB to Ethernet networks. This enables communication between network clients and the CDB over large distances using standardized network components. The output of the data to the Ethernet interface is ASCII-coded. The individual values are separated from one another by a semicolon (CSV). The transmission is concluded with a carriage return (CR, 0x0D).

In addition to the Telnet server, the IFFE provides an HTML page which can be accessed via any web browser using the http protocol. A dedicated UDP broadcast can be used to find the CDB in the network.

For details about the data communication with the Ethernet interface for the CDB, please contact the ASTECH company.

8.7 Analog output (not legally relevant, optional)

The IAUN interface card provides an optically isolated analog output (current interface) with a 16-bit resolution. There are three versions with different current ranges available: IA00 (0-20 mA), IA40 (4-20 mA) and IA04 (0-24 mA). The interface card is installed in the VLM500. The connection is made via connector 1 of the VLM500.

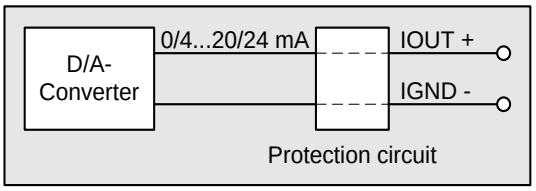


Figure 29: VLM500 analog output

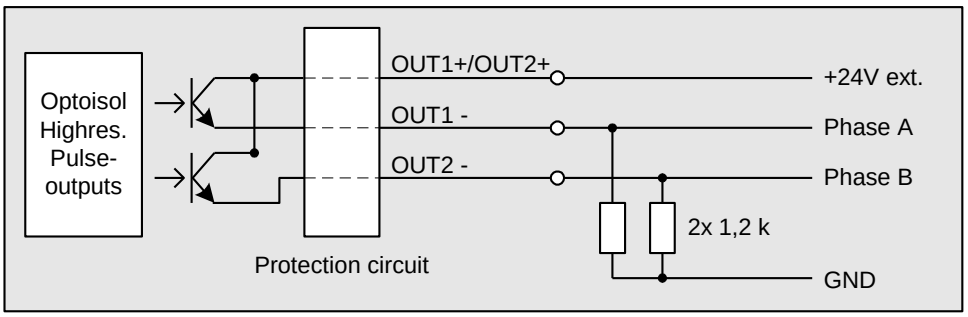
8.8 Pulse output for encoder emulation (not legally relevant, optional)

To control a drive or to count pulses, the VLM500 can be equipped with one or more optional, non-legally relevant pulse outputs. There are three different types of pulse outputs available, which are described in the following sections.

8.8.1 Open Collector

The expansion card IPPL provides a high-resolution pulse output with two phases in a frequency range of 0.2 Hz to 25 kHz. The resolution and the maximum error are 8 ns each. A cable with a maximum length of 50 m can be connected to this connection.

The two outputs are isolated galvanically by optocouplers. The output is scalable. A 90° out-of-phase clock is provided. The transistors of the octocouplers can drive a max. current of 30 mA each. The manufacturer recommends a current of about 20 mA. With an external applied voltage of 24 volt the load resistances should be 1.2 kOhm each, in order to reach a load current of 20 mA. The load can also be an optocoupler. The outputs are protected against short circuit and overvoltage. The pin assignments of connector 4 of the VLM500 can be found in the appendix.



8.8.2 Push Pull 5V (IP5V)

The IP5V expansion card provides a high-resolution pulse output with two phases (90 ° phase shift) in a frequency range from 0.2 Hz to 2 MHz. The resolution and the maximum error are 8 ns. The output resistance is 200 ohms. The maximum output current is ± 100 mA per channel. The outputs are equipped with a switch-off protection in the event of a thermal overload (e.g. due to an excessively high current). The outputs are galvanically isolated by optocouplers, but have the same reference potential. The maximum cable length for asymmetrical operation (reference potential O-GND) is 200 m or for output frequencies below 50 kHz it is 500 m.

The outputs are designed as 5 V driver stages. No external power supply is required. An IP5V card can be installed up to three times in the VLM. The pin assignments of connector 4 of the VLM500 can be found in the appendix.

The card can drive RS-422 inputs with a 100 Ohm terminating resistor. The connection is symmetrical between OUTx and / OUTx. The GND-connection is not used. When using twisted-pair and shielded cables (e.g. CAT5), the maximum cable length for the RS-422 is 500 m.

8.8.3 Push Pull 24V (IPPP)

The IPPP expansion card provides a high-resolution pulse output with two phases (90 ° phase shift) in a frequency range from 0.2 Hz to 2 MHz. The resolution and the maximum error are 8 ns. The output resistance is 200 ohms. The maximum output current is ± 100 mA per channel. The outputs are equipped with a switch-off protection in the event of a thermal overload (e.g. due to an excessively high current). The outputs are galvanically isolated by optocouplers, but have the same reference potential. The maximum cable length for asymmetrical operation (reference potential GND) is 200 m or for output frequencies below 50 kHz it is 500 m.

The driver stages of the outputs are supplied with an additional voltage (Vext) between + 12V and + 30V, which also determines the voltage level of the pulses. This auxiliary voltage can be supplied externally via a cable and connected to the screw terminal strip from the connection flange. Alternatively, the VLM500 supply voltage (24V) can be used. In this case, a cable bridge must be placed on the screw terminal strip inside the VLM500. An IPPP card can be installed up to three times in the VLM500. The pin assignments of connector 4 of the VLM500 can be found in the appendix.

The outputs of the IPPP expansion card are protected against ESD. Since these are active outputs, they must not be short-circuited with an external voltage, as this will destroy the outputs. Voltages> + 30V at the V_{ext} (IPPP) input are not permitted!

8.9 Process data output (not legally relevant, optional)

The following sections describe interfaces that are used exclusively for outputting process data. These are completely separate from the protocol output interfaces described above.

The VLM500 can be equipped with a process data output interface to monitor length, speed or rate. The values are continuously transmitted to a PLC. The pin assignments of connector 5 of the VLM500 can be found in the appendix.

The following interfaces are available:

- Profinet IO,
- EtherNet/IP and
- Ethernet.

8.9.1 Profinet IO

The Profinet interface provides a webserver to display device information and the process values on a http page. The address is the IP address (port 80) of the VLM500 in the network (see Figure 30).

Connection

The connection to the housing flange is via a round plug connector M12, 4-pin, D-coded, Binder series 715.

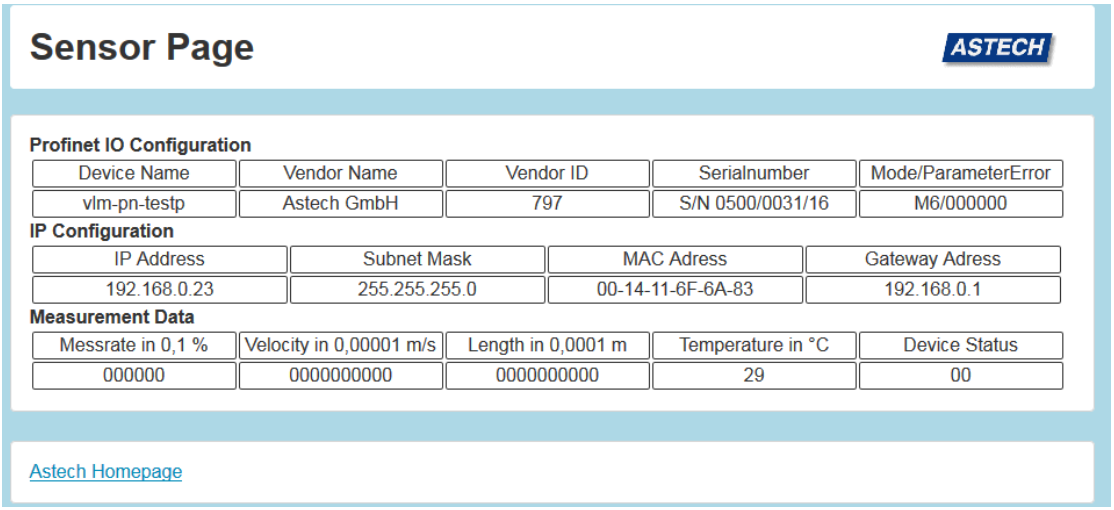


Figure 30: VLM500 Profinet sensor page

VLM500 - parameter

The correct settings of the internal serial interface VLM500 for outputting the process data are as follows:

- *SO2ON 1* (mandatory)
- *SO2INTERFACE 57600 N* (mandatory)
- *SO2FORMAT* (see Table 5)
- *SO2SYNC 0* (time synchronous)
- *SO2TIME 20* (see Table 5)
- *AVERAGE* (same as *SO2TIME*)

Configuration

The Profinet interface is configured via the Profinet IO controller. Interface-specific parameters such as the IP address to be used, the subnet mask, the gateway, the device name or the data mode (see Table 5) can be changed. The device description file (GSDML) for the Profinet IO controller is available for download on the ASTECH website and is part of the scope of delivery.

The following two notes must be observed when exchanging data:

The parameterization of the VLM500 must correspond to the mode used, which is set by the user in the Profinet IO controller.

The speed output via Profinet is always unsigned! If the sign is required, mode 6 must be selected.

Table 5: Profinet Process data modes

Mode	Profinet IN (IFPN output)	VLM parameter SO2FORMAT	VLM parameter SO2TIME
M1	16 Bit counter, 32 Bit speed, 16 Bit measurement rate	*Z*	≥ 12 ms

M2	16 Bit counter, 32 Bit speed, 16 Bit measurement rate 32 Bit Integral of speed, 32 Bit 1 ms Timer	*Z*	≥ 17 ms
M3	<not in use>		
M4	16 Bit counter, 32 Bit speed, 16 Bit measurement rate 32 Bit length	*Z L:H*	≥ 15 ms
M5	<not in use>		
M6	16 Bit counter, 32 Bit speed, 16 Bit measurement rate 32 Bit length 8 Bit VLM – error number 8 Bit device status (see below) 8 Bit device temperature	*Z L:H U:H:2 H:H:2*	≥ 20 ms

The scaling is as follows: speed in 0.000001 m/s; length in 0.0001 m; measurement rate in 0.1%. All values are transmitted unsigned.

Device status

In mode 6, the device status is transmitted to the master as a byte. The byte has the following structure:

Bit 7 - 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Sign of length	Direction (Sign of speed)	Status of output STATUS	Status of output ERROR
	0 … positive 1 … negative	0 … positive 1 … negative	0 … no signal 1 … signal acquired	0 … no error 1 … error detected

Control byte (Profinet OUT)

The VLM500 can be set using the control byte. The control byte has the following structure:

Bit	meaning	type	remark
0	Standby	level	Puts the VLM500 into power saving mode LOW- level: <nothing> HIGH- level: Standby
1	<not in use>		
2	Standby	level	Puts the VLM500 into power saving mode LOW- level: <nothing> HIGH- level: Standby
3	<not in use>		
4	Clear	edge	rising edge: reset VLM errors falling edge: < nothing >
5	<not in use>		
6	<not in use>		
7	<not in use>		

8.9.2 EtherNet/IP

The EtherNet/IP interface provides a webserver to display device information and the process values on a http page. The address is the IP address (port 80) of the VLM500 in the network (see Figure 30).

VLM500 - parameter

The correct settings of the internal serial interface VLM500 for outputting the process data are as follows:

- *SO2ON 1* (mandatory)
- *SO2INTERFACE 57600 N* (mandatory)
- *SO2FORMAT Z L:H U:H:2 H:H:2* (mandatory)
- *SO2SYNC 0* (time synchronous)
- *SO2TIME 20* (mandatory)
- *AVERAGE* 20 (mandatory)

Configuration

The EtherNet/IP interface is configured via the EtherNet/IP scanner (bus master). Interface-specific parameters such as the IP address to be used, the subnet mask and the gateway can be changed. The VLM receives its settings by default via DHCP. If no DHCP server is available, the IP address 192.168.0.51 applies to the VLM. The device description file (EDS) for the EtherNet/IP scanner is available for download on the ASTECH website.

The speed output via Ethernet/IP is always unsigned!

Data structure

All values are transferred as an amount! The sign of the speed and length is coded in the device status.

Table 6: EtherNet/IP data structure

Data format output VLM to scanner (master)	VLM parameter SO2FORMAT	VLM parameter SO2TIME
16 Bit counter 32 Bit speed 16 Bit measurement rate 32 Bit length 8 Bit VLM – error number 8 Bit device status 8 Bit device temperature	*Z L:H U:H:2 H:H:2*	≥ 20 ms

The scaling is as follows: speed in 0.000001 m/s; length in 0.0001 m; measurement rate in 0.1%.

Device status / Control byte

The structure of the device status byte and the control byte is the same as for the Profinet interface. Refer chapter 8.9.1 for more information.

8.9.3 Ethernet

For information about the Ethernet interface please contact ASTECH company.

9 Maintenance

9.1 General

The VLM500-MID works optically. It is dependent on seeing the measurement object. Thus, it is necessary to check the VLM500 window in regular intervals and clean it, if necessary. The cleaning should be made with a soft, lint-free cloth and customary glass cleaner. All other surfaces should be cleaned the same way in regular intervals.

9.2 VLM500 - Window

Damaged windows must be exchanged. The device must be disassembled from the plant and cleaned for this. The window exchange must take place in a clean environment only. The four hexagon socket screws (wrench opening 2.0 mm) must be unfastened. The window can be lifted from the sealing with a flat screwdriver. The

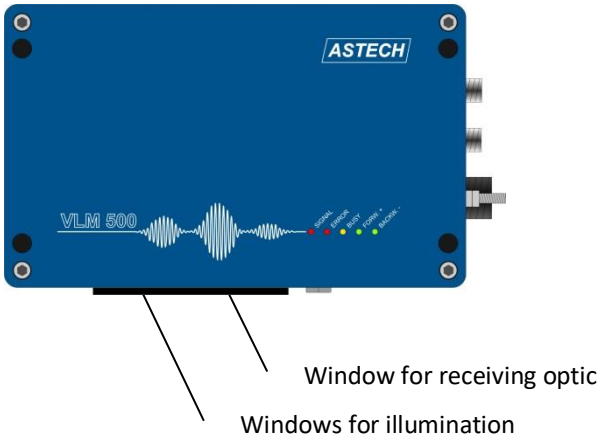


Figure 31: Window of the VLM500

inner side of the window and the lenses must not be touched! The new window must be fastened with four bolts.

Table 7: Replacement windows

Device	Replacement window objective	Replacement window light
Stainless steel window as option	OW5	OW5
All other VLM500	OW2	OW2

Use the correct replacement windows, the original sealing and the original bolts only.

The windows OW 2 and OW 3 are made of special glass with high transmission. The window OW 4 reflects infrared radiation. The windows OW 3 and OW 4 have a higher temperature resistance. The optional window OW 5 is resistant against oil, petrol and kerosene and mechanically more resistant than standard windows OW 2.

Furthermore, special plastic windows are available that, for instance, can be used in food industry fields due to their breakage safety.

If the windows must often be cleaned or wear out fast, possible safety measures must be taken (e.g. blowing device PA2 or cooling and protection housing CB5 with air generation AC5).

9.3 LED lamp

A special LED with high luminous efficiency is used in the VLM500. Still, the brightness decreases with increasing operation time. The average decrease is 70 percent after 50,000 hours at 80 °C chip temperature according to manufacturer statement.

The LED is aligned and fixed on an aluminum block. The block is guided through two register pins and fastened with a hexagon socket screw (3 mm). The electrical contacting is made with two plug connectors. Thus, the exchange can be implemented quickly and easily. The LED lamp can be bought at the dealer or directly at the manufacturer. Light sources not yet assembled are very sensitive. We kindly ask you to handle them with extreme care. The lens must not be touched or damaged. Light sources that have not been installed yet are very sensitive! New light sources must be stored in original manufacturer packaging only. Take the light source out of the packaging just before installation.

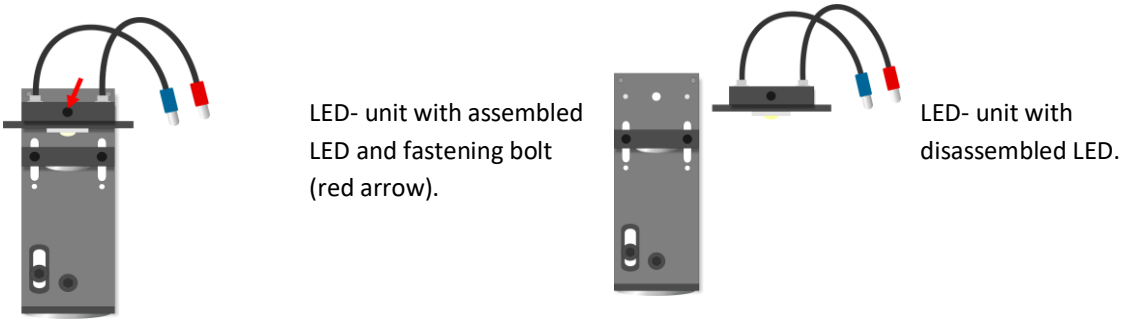
Secured mode

If the VLM500-MID is in the secured operating mode, the housing of the VLM500 is sealed. A change of the light source is only possible if the seal is removed. Changing the light source has no effect on the measuring behavior of the VLM500-MID. The user should think about changing the light source as part of a new calibration. If necessary, the manufacturer should be contacted.

The lamp can only be changed when the housing cover is open. An existing seal must be removed for this!

Exchange of the lamp

1. The device must be separated from the current supply before continuing. Clean the device outside before exchanging the light source. Under particularly adverse circumstances, the device should be taken out of the device to carry out the exchange at a cleaner place. No dirt must get inside the device!
2. The four hexagon socket screws must be unfastened and the housing lid of the VLM500 must be removed. Now unfasten the two plug connectors and the hexagon socket screw (see red arrow). Afterwards, the old LED-unit can be removed.
3. The new LED-unit must be cautiously inserted, no tilting must occur! The glass of the new light source must not be touched! No component on circuit boards must be damaged when opening inside the device!
4. Afterwards, the socket screw must be fastened and the plug connector must be plugged together up to stop, to ensure that the contacts are fully isolated by the protection caps. The cables must not be placed on the optical path of the illumination unit!
5. The device must be closed properly and the current supply connection must be reestablished afterwards.



LED- unit with assembled LED and fastening bolt (red arrow).

LED- unit with disassembled LED.

Figure 32: Exchange of the LED-unit

10 Service application VLMTool

The service interface on the CDB housing is used for programming. When setting up for the first time, do not connect the CDB to your PC. Install the VLMTool program for Windows 10 from the USB stick included in the delivery. The software can also be downloaded from the Internet: https://astech.de/download.html.

After the installation, the wizard asks whether the driver for the USB interface should be installed. Please confirm this question and have the USB driver installed. After restarting your PC, you can connect the CDB using the interface cable included in the scope of delivery.

The functional range of the VLMTool depends on the mode the VLM500-MID is currently working: secured or unsecured mode! All VLMTool function are only available when the programming adapter is applied to the CDB, which means the device is in unsecured mode.

When the software is started for the first time, the program settings open automatically. The COM port that Windows set up during the driver installation must be selected in the Port settings tab. The communication speed is 115200 baud. After closing the dialog window, the software automatically tries to establish a communication with the CDB. When the device has been found, the device ID, the firmware version and a picture of the CDB are displayed in the upper area of the program window. Commands can be entered via the input line. Parameter changes in the CDB are always saved automatically and are retained after a device restart.

Parametrization VLM500

A communication channel must be established in the CDB to parameterize the VLM500. This means that all commands from the PC are forwarded directly to the VLM500 via the CDB. To establish the communication channel the menu entry “Action/Connect to VLM” can be selected (key combination „STRG + F“)[15]. After a security query, the CDB switches to the communication channel. The VLMTool searches now for the VLM500 and shows the VLM500 serial number, the firmware version and a picture of the device in the upper area of the program window.

If the communication channel between the PC and VLM500 is established, no length measurements can be made with the CDB!

Now all parameters can be changed using the command line or the parameter mask. All test functions, the Length-Recorder and the Signal-Viewer can be used.

To end the communication channel, you can press the right button of the CDB key pad, close the VLMTool or press the “Back to CDB” button shown over the VLM picture of the VLMTool. In any case the VLM500-MID restarts and after the boot process length measurements can then be made again.

Software update

Software updates for both the CDB and the VLM500 can only be carried out in an unsecured mode. The current firmware can be downloaded from the ASTECH GmbH website.

The power supply to the VLM500-MID must not be interrupted during a firmware update. If this happens anyway, a service call may be required or the device must be sent to the manufacturer.

[15] The communication channel calls the CDB command *%COMVLM*.

11 Commands and parameters of the VLM500

11.1 Notes on use

There are different command groups that are implemented in the VLM500-MID. There are commands that change a parameter and commands that output information about the device. There are also test commands for observing the measurement properties. When entering commands, so many characters must be entered until the syntax is clear. In the following command documentation, the minimum characters to be entered for a command are printed in **bold**.

The VLM500-MID does not differentiate between lowercase and uppercase letters in the commands. Parameters are separated by spaces. The decimal point is used to separate the places before and after the decimal point. When entering commands without parameters, the current value of this parameter is displayed. All commands described here are listed again in the appendix (see Chapter 14.1). The preset specified in the list may have already been adjusted ex works.

If parameter changes in the VLM500 shall be made permanent, the command *STORE* must be called before the device is turned off or restarted.

11.2 Permitted parameter changes in secured mode

When the VLM500 is in the secured (calibrated) mode, changes to legally relevant parameters are prohibited. This is ensured by the sealed programming adapter connection (connector 2 of the CDB). If the user tries to change a value anyway, the change is ignored and the currently set value is output instead.

There are two groups of commands that are excluded from this limitation. These are parameters that control the behavior of optional interface cards (pulse output, analog output).

11.3 Test mode

In order to carry out test measurements (e.g. speed diagram, behavior of the measuring rate etc.) with the VLM500-MID, the menu item "Test mode" must be called up via the user interface. Refer chapter 5.7. This is a special mode that can only be used with the VLM500 itself. No length measurement values can be saved in the CDB. In this mode all parameters in the VLM500 can be changed. This allows the influence of parameters on the measurement behavior of the VLM500 to be assessed to the operator. It is not possible to save parameters permanently. When exiting the test mode (by restarting the entire VLM500-MID device), any parameter changes are discarded and the previously legally relevant parameters are restored and used for legally relevant measurements.

11.4 Type and device-specific parameters

The VLM500-MID does not differentiate between the type and device-specific parameters. There are only the device-specific parameters "constant" and "tcomp". These parameters cannot be changed by the user and are therefore not actually available as parameters. They are determined during device production and stored in the device.

There are parameters that are relevant if a corresponding interface is installed in the VLM500-MID. If the interface is not installed, the commands can still be executed and the associated parameters can be changed. However, this has no effect on the device behavior.

11.5 Commands for system information

Command	Description	Syntax
AO	This command shows all parameters of the analog output.	***AO***
Constant	The command returns the system constant. This constant contains several calculation factors for the velocity that results from different lenses and magnification factors. The default setting is made ex works and is not changeable.	***Cons**tant*
Error	The last five error codes that occurred are displayed with the command. The code 'E00 No ERROR' means that no errors have occurred. Critical errors are acknowledged after invoking the command. Fatal errors are saved because the device must be repaired or the user's intervention is required.	***Er**ror*
Fmax	This command returns the maximum allowed measuring frequency of VLM500. The value serves only the information and is calculated from Vmax and other parameters.	***Fm**ax*
Info	This command displays the device information with software version and serial number such as after switching on the device. The command *POST* must be used to display further information about the interfaces found.	***Inf**o*
Listerror	Certain critical and fatal errors are stored permanently in an error list. They are stored with time and date when they appeared. With this command the error list can be read out. It cannot be deleted. The list provides 124 entries. When it is exceeded, the oldest entry will be overwritten.	***Liste**rror*
Parameter	The command lists the current setting of all parameters. Option: *c* Only the main parameters are displayed.	***Par**ameter* [c]
PO1 PO2 PO3	Display of all pulse output parameters for pulse output 1, 2 and 3 respectively.	***PO1*** ***PO2*** ***PO3***
Post	The command Post (power-on-self-test) starts a self-test of the device and shows the found interfaces. The basic boards are always listed. Optional interfaces are only listed if installed Option: *d* Shows out an overview of all hardware options regardless if installed or not.	***Po**st [c]*
Serialnumber	With this this command, the serial number of the device is displayed.	***Ser**ialnumber*
SO1	Displays all parameters of the VLM500 serial interface 1.	***SO1***
SO2	Displays all parameters of the VLM500 serial interface 2.	***SO2***
TComp	The command displays the value for the temperature compensation in PPM/K. The deviation of the current temperature from the reference temperature and the value of *TCOMP* are directly included into the velocity calculation. The presetting is made ex works and is not changeable.	***TC**omp*

Command	Description	Syntax
Temperature	Two temperatures are displayed in °C unit from inside the device. As soon as 75 °C is exceeded the Error 'E31 Over temperature detected!' is activated.	***Tem**perature*
Tmax	The command displays the maximum reached temperatures in the housing. The data is time-stamped.	***TMa**x*
Tmin	The command displays the minimum reached temperatures in the housing. The data is time-stamped.	***TMi**n*
Type	The command displays the type of measuring device.	***Ty**pe*

Short commands

Read commands serve for asynchronously reading out measuring values. They are processed particularly fast by the command interpreter. All read commands are inserted with a letter and implemented after the following CR (0X0D).

Command	Return value	Unit	Decimal precision	Example
L	Length	m	4	1234.5678
R	Measuring rate	-	0	45
V	Velocity	m/s	5	-1.23456

11.6 Legally relevant parameters

The parameters listed here should only be changed if instructed by a trained service employee or the manufacturer. The default settings are adjusted to the device and the area of application at the factory and should normally not be changed!

The command *Amax*

The command is used for setting the parameters for the maximum allowed acceleration with which the VLM velocities can be processed. The value is only important for the Tracking modes 5 and 6.

Syntax: ***Ama**x* [f] (f = 0.0 ... 10.0 or 0) Unit: m/s²

The command *Amplifier*

With this command, the maximum amplification of the measuring signal can be set. For *Amplifier a*, an automatic control depending on the signal strength takes place.

Syntax: ***Am**plifier* [n] (n = 0 ... 3 - fixed, a - automatic)

N	Amplification	N	Amplification
0	1x	3	1...8x
1	1...2x	A	Automatic
2	1...4x		

The parameter should be left to the setting automatic.
Failures or error messages can happen with the incorrect setting of the parameter.

The command *Average*

The command is used for setting the averaging time for the velocity and measuring rates calculation. The internal calculation of the length is independent from the set averaging time! In the time set by *Average*, all accruing signals (bursts) are compressed to an average value. The mean value can then be output in the respective interfaces. The command without parameter returns the averaging time

The value should be chosen as large as the process dynamics allows. The usual values are 5 to 50 ms (100 to 250 ms for the VLM500L).

A too long average leads to a delayed reaction on velocity changes. With very strong velocity changes, signal failures can happen in rare cases. If the *Average* is too short, the measured value fluctuates more strongly on the contrary. Hence vibrations from the measurement object or the measuring device are visible in the signal curve.

Syntax: ***Av**erage* [f] (f = 0.2 ... 10000 or 0 for external clock) Unit: ms

Furthermore, the parameter *Window* (see page 65) offers a floating averaging up to 32 values.

External clock: Setting “average 0” allows an externally triggered output and calculation of the velocity values. This is useful for differential speed measurements with two VLM500.

The command *Bw*

This command determines the filter bandwidth of the filterboard and, thus, the possible signal tracking (acceleration) of the VLM500. Still, the parameter *Tracking* (see page 62, The command *Tracking*) is mainly decisive and should be prior used. The bandwidth is indicated in percent related to the current measuring frequency. The value ‘a’ sets the bandwidth to automatic.

To enable higher acceleration than specified in the technical data, an adaptation can be carried out by trained service.

Syntax: ***Bw*** [n] (n = 10 ... 75 - fixed, a - automatic)

n	Bandwidth		Installed filter board	Mode
0	Automatic	20%	FB3 (VLM500 A/D/L/E)	0
		25%	FB3 (VLM500 A/D/L/E)	1
		25%	FB2V (VLM500 A/D/L/E)	-
10	10%		-	-
50	50%		-	-

The parameter should be left to the setting automatic.
Failures or error messages can happen with the incorrect setting of the parameter.

The command *Calfactor*

With this command it is possible to enter a calibration factor manually or display it. The value of the calibration factor is usually close to one. The factory setting is 1.000000. The use of the calibration factor for scaling an output channel is not permitted. Therefore, the respective parameters of the respective interfaces are used.

Syntax: **Cal**factor [f] (n = ± 0.950000 ... ± 1.050000)

Calculation of the calibration factor from the length indicated by VLM500 or velocity and the actual values:

$$NewCalFactor = OldCalFactor \cdot \frac{Actual\ Value}{Displayed\ Value}$$

When the calibration factor is entered as negative value, the sign of the speed and length values is inverted. The meaning of the parameter Direction remains unaffected.

The command *Calibrate*

A calibration of the velocity or length is carried out with this command. Only figures are used, that is, negative velocity or length values are converted to positive. The progress of the measurement is displayed in percentage during the calibration; the BUSY display (yellow) glows. A cancellation can be made with ESC. The new calibration factor is displayed after completion of the measurement. The value must be saved with *Store* like all other changes of the parameter!

The calibration factor is calculated according to the following formula:

$$CalibrationFactor = \frac{Set\ Value}{Actual\ Value}$$

Syntax: ***Cali**brate* c, n, f (c = 'V', 'L')
(n = 1 ... 65535)
(f = 0.0001 ... 10000)

Parameter: c - 'V' = Velocity calibration
'L' = Length calibration
n - Calibration duration in seconds (for velocity calibration)
Number of measuring objects (for length calibration)
f - Nominal value in m/s (for velocity calibration)
Nominal value in m (for length calibration)

Signalerror can be set to 1 in order to increase the certainty of the calibration; thus velocity 0 is forbidden. It is also possible to set a minimum measuring rate via *Minrate*. Should this value come below, an error message ensues.

The command *Clock*

The time of the real-time clock is indicated and set with Clock. The input of the seconds is optional here. Clock without parameter returns the time in format hh:mm:ss.

Syntax: ***Cl**ock* [hh:mm:[ss]]

The command *Controltime*

The VLM500 has automatic control for the exposure time for highly reflecting or changing surfaces and lamp intensity. If a measurement object is too dark, then the device can be underloaded. This has effects on the signal quality, but does not interrupt the measurement. If, however, the VLM500 is overloaded, thus signals could no longer be received and it results into a measurement failure. To prevent this, several mechanisms were implemented that react before an overload and down-regulate the lamp intensity, for example.

When measuring on surfaces that show strong distinctions in their quality and after a bright spot must be blocked this parameter *Controltime* specifies how much time must pass until the VLM500 attempts again to increase the lamp intensity and exposure time. The standard value is 0.1 seconds.

Syntax: ***Cont****roltime* [f] (f = 0.01 ... 1.00) Unit: s

The command *Controlhold*

The command allows the freezing of the control loops for adjustment to the brightness of the material surface dependent on the trigger state (see page 63, The command *Trigger*). There are different application fields:

The control loops for the time are locked with *Controlhold 1* in which no part is located in the measuring window (Trigger inactive), that is, the valid values for exposure time and lighting brightness at the end of a part are held until the beginning of the next part. If the individual parts have different colors or surface properties, then *Controlhold* should be switched off.

Syntax: ***Controlh****old* [n] (n=0 – off, 1 – on)

The command *Date*

The date of the real-time clock is displayed and set with *Date*. *Date* without parameters returns the date in format dd.mm.yy.

Syntax: ***Da****te* [dd.mm.yy]

The command *Epsilon*

The frequency generated in the VLM500 by the measurement principle is evaluated. The single periods are tested for plausibility (similarity to previous periods). In case of validity, the individual periods are summarized to a burst and the period duration is measured. The frequency is hence calculated and then converted in a velocity.

The first value of the parameter *Epsilon* thereby returns the allowed percent deviation of each period to the previous, so that it is classified as valid. The higher this value is set, the worse signals the signal processing allows. Incorrect measurements happen with a too high value!

The second value of the parameter is optional and it is only used if it is set as filter principle Tracking 5 or 6 (see page 62, The command *Tracking*). If it is set to 1, other Epsilon values (2. Epsilon table) are used independently by VL500 for low velocities. The input of the second value is only possible if the first is set to automatic.

Syntax: ***Ep****silon* [f] [c] (f = 0.787 ... 50.0 – fixed, a – Automatic) Unit: %

(c = 0 – 2. Epsilon table off, 1 – 2. Epsilon table on)

The parameter should be left to the setting automatic.
Failures or error messages can happen with the incorrect setting of the parameter.

The command *Exposure*

The exposure time of the CCD sensor is set with this command. The maximum adjustable value depends directly on the maximum object velocity *Vmax* and thus also on *Mode*. The higher the velocity selected, the smaller the maximum values for *Exposure*. The setting *Exposure a* allows an automatic control whose limits are set by *Expmax* and *Expmin*.

Syntax: ***Expo****sure* [n] (n = 0 ... 14 – fixed, a – automatic)

For required accuracy better than 0.05, *Exposure* is set fixedly to a small value (e.g. 0 or 1, depending on the application). Otherwise, the value a (automatic) is recommended for maximum material independence.

With bright materials with structure, a locking of *Exposure* to a small value can also be useful in order to prevent a constant readjustment of the exposure time.

The command *Expmax*

This command sets the maximum value of the exposure time of the CCD line (see page 55, The command *Exposure*) that can be accepted by its automatic control. The maximum adjustable value depends directly on the maximum object velocity *Vmax* and thus also on *Mode*. The higher the velocity selected, the smaller the maximum values for *Expmax*. In setting *Expmax* a, the maximum allowed *Expmax* is used automatically. The value must be greater than or equal to *Expmin* in fixed values.

Syntax: ***Expmax*** [n] (n = 0 ... 14 – fixed, a – automatic)

> The parameter should be left to the setting automatic.
> Failures or error messages can happen with the incorrect setting of the parameter.

The command *Expmin*

This command sets the minimum value of the exposure time of the CCD line (see page 55, The command *Exposure*) that can be accepted by its automatic control. The minimum adjustable value depends directly on the maximum object velocity *Vmax* and thus also on *Mode*. The lower the selected velocity, the greater the minimum value for Exp*min*. In setting Exp*min auto* the minimum allowed Exp*min* is used automatically. The value must be smaller than or equal to *Expmax* in fixed values.

Syntax: ***Expmin*** [n] (n = 0 ... 14 – fixed, a – automatic)

> The parameter should be left to the setting automatic.
> Failures or error messages can happen with the incorrect setting of the parameter.

The command *Direction*

The source for the direction switching is set with this command. If the movement direction of the measuring object and the direction specified in Direction Plus (+) in the device by an arrow coincide, thus it is defined as forward. *Direction* is not allowed in devices without the optional direction recognition!

> Faulty measurements occur in incorrectly adjusted direction. The error can increase with increasing velocity!

Syntax: ***Dir****ection* [n] (n = 0 ... 3, a)

n	**Meaning**		
0	Forward		
1	Backwards		
2	External to 'DIR'	0 V to +8 V:	Forward
		+10 V to +30 V:	Backwards
3	External to 'DIR'	0 V to +8 V:	Backwards
		+10 V to +30 V:	Forward
a	Automatically (only devices with direction recognition, optional)		

If the direction is controlled via a field bus, it is mandatory to set the parameter Direction to 2 or 3.

The command *Holdtime*

If a signal failure occurs during a measuring process, a duration can be specified with this command in which the last recorded velocity value is kept on the corresponding interface. If the signal turns out longer than *Holdtime*, then null is returned. A second optional parameter of this command allows giving a reaction time [n2]. In using the reaction time, 'STATUS' turns on already according to *Holdtime* shortened by the reaction time [n2]. This is displayed by the red signal LED. This allows a device connected via 'STATUS' (e.g. SPS) to react before *Holdtime* has actually expired.

The value of *Holdtime* should normally be chosen greater or equal to *Average*. Common values for *Holdtime* are 50 ms to 1000 ms.
In using the internal length measurement, *Holdtime* must be smaller than the minimum time lag of two individual parts! That means that *Holdtime* needs to be shorter than two subsequent trigger events.
The value for *Holdtime* [n1] must be greater than the reaction time [n2].

Syntax: ***Ho****ldtime* [n1] [n2] (n1 = 10 ... 65535) Unit: ms

(n2 = 9 ... 65534) Unit: ms

The command *Illumination*

This command controls the intensity of the LED illumination. The setting *Illumination a* allows an automatic control whose limits are set by *Illmax* and *Illmin*.

Syntax: ***Illu****mination* [n] (n = 0 ... 30 – fixed, a – automatic)

The parameter should be left to the setting automatic.
Failures can happen through overloading and underloading by the incorrect setting of the parameter.

The command *Illmax*

This command sets the maximum value of the LED intensity (see page 57, The command *Illumination*) that can be accepted by its automatic control. The value must be greater than or equal to *Illmin*.

Syntax: **Illma**x [n] (n = 0 ... 30)

The parameter should be left to the setting 30.
Failures are possible by underloading in incorrect setting of the parameter.

The command *Illmin*

This command sets the minimum value of the LED intensity (see page 57, The command *Illumination*) that can be accepted by its automatic control. The value must be smaller than or equal to Illmax.

Syntax: ***Illmi****n* [n] (n = 0 ... 30)

The parameter should be left to the setting 0.
Failures are possible by overloading in incorrect setting of the parameter.

The command Lengthoffset

With this command it is possible to add an offset value to the optical noncontact measured length. In this manner the distance of two light barriers can be programmed directly. When *lengthoffset* is greater zero, the offset is added to every length output done by the VLM.

Syntax: ***Length****offset* [f] (f = -999.9999 ... 999.9999)

The command *Minrate*

The measuring rate monitoring is activated with the command *Minrate* and a parameter greater than 0. *Minrate* without parameter omits the set value.

If the set measuring rate falls below, then the signal LED glows red and the output 'STATUS' is opened.

A pollution control for the window can, for example, be programmed with the command *Minrate*. Useful values for *Minrate* are 5 to 20. The monitoring of the measuring rate occurs every time after the time set by the command *Average*. *Average* should not be chosen too small at low velocities. Attention should be paid that in material standstill or when there is no material in the measuring window, the output 'STATUS' is opened and the signal LED glows red.

Syntax: ***M****inrate* [n] (n = 0 - off, 1 ... 99 - on)

The command *Mode*

The internal signal processing of the VLM500 is switched with this command. Attention should be paid that the velocity range and the technical data change with *Mode 1*.

The use of *Mode 1* can be useful in order to match the optical resolution of the device to the surface structure of the measuring object. Thus, a higher signal rate can be achieved with rough structures (e.g. rough steel, timber, paper). At higher velocities they are absolutely necessary in part.

Syntax: ***Mode*** [n] (n = 0 - single grid, 1 - double grid)

The command *OED*

This command controls the function of the quick overexposure detection.

Syntax: ***OED*** [n] (n = 0 – off, 1 – on)

The fast overloading detection should only be switched on, if bright measuring objects enter in the measuring window (e.g. single part measurement in test facility for pipes and profiles of stainless steel). If the guide is not good, do not turn on the detection!

The command *Permax*

This command sets the maximum number of periods that a burst can have before it is broken down in partial bursts or periods. *Permax 0* forces a reduction in single periods, if possible, in order to reach a maximum dynamic.

Syntax: ***Perma****x* [n] (n = a – dynamics, 16, 32, 64, 128, 240 - fixed)

The parameter should be generally left to the setting a (dynamics).

The command *Permin*

This command sets the minimum number of periods that a burst must have in order to be used for the other velocity calculation. The setting *Permin a* allows an automatic control based on the maximum velocity of *Vmax*.

The command can be fed with a second optional value. This second value can only be used if Tracking 5 or 6 is set as filter principle. It returns the minimum number of periods that a burst must have if the dynamic minimum periods adjustment is made by Tracking 5 or 6. The input of the second value is only then possible if the first is set to automatic!

Syntax: ***Permin*** [n1] [n2] (n = 2 …15 – fixed, a - Automatic)

(n2 = 2…15 – fixed)

The parameter should be left to the setting automatic.
Failures or error messages can happen with the incorrect setting of the parameter.

The command Rateinterval

A quality criterion for the measurement results is the so called ‘Rate’. The better the spatial filter signals are, the higher is the rate. For the calculation of the rate an average value is used. The length of the average is set by the command Rateinterval.

Syntax: ***Rate****interval* [f] (f = 5 …100) unit: ms

Keep in mind, that the higher Rateinterval is, the unlikelier is the chance to recognize sudden changes in the rate induced by process changes. In normal cases the value should be left unchanged.

The command *Senslevel*

This command sets the sensitivity threshold of the periodic time analyzer. This can be required if the measurement object shows a weak surface structure.

Syntax: ***Sen****slevel* [n] (n = 0 ... 3)

n = 0 - very sensitive, for weak measurement signals

n = 3 - less sensitive, strong measurement signals

The parameter should be left to the factory setting.
Failures or error messages can happen with the incorrect setting of the parameter.

The command *SO1Format*

In addition of the programming, data output can also take place via the first serial interface. The transmission format can be given within wide limits. The output ensues in ASCII. The individual parameters can be separated by spaces, commas or periods. However, the separators between the parameters can also be omitted.

Syntax: ***SO1F****ormat [s]* (s - parameter string, max. 42 characters)

Parameter	Meaning
'...'	Inserts the string enclosed in quotation marks
0...9	Numbers (0 to 255) that are not enclosed in quotation marks are interpreted as ASCII Code and output as the corresponding ASCII character
C	Inserts the current time (e.g. 12:50:28)
D	Inserts the current date (e.g. 31.12.2010)
E	Inserts the exposure (0 to 14)
F	Inserts the measuring frequency in Hz
H	Inserts the temperature of the first temperature sensor in °C
I	Inserts the lamp intensity (0 to 30)
J	STANDBY, TRIGGER 1 and DIR as number in BCD coding (STDBY=2^3, TRIG1=2^2, DIR=2^1)
L	Inserts the length in m
N	Inserts the status of the object counter (0 to 65535)
Q	Inserts the product (0 to 100) from lamp intensity and exposure time
R	Inserts the measuring rate (0 to 100)
S[16]	Inserts several fixed hexadecimal values in succession: Velocity in m/s * 100000 (24 bits = sign + 6 nibbles) <SPACE> Measuring rate * 10 (12 bits = 3 nibbles)
T	Disables the standard identifier CR LF of the output string
U	STATUS, ERROR and direction in BCD- coding (direction=2^2, STATUS=2^1, ERROR=2^0)
V	Inserts the velocity in m/s
X	Inserts the last error number
Z	Same as S with 2 additional nibbles for last error numbers

Format	Meaning

[16] The special format S carries out a fast output of the velocity and measuring rate.

a+x	Adds the value a (V, L, F, ...) with the offset x
a*x	Multiplies the value a (V, L, F, ...) with x
a:H[:n]	Returns the value a (V, L, F, ...) as hexadecimal number with n characters[17]
a:n[:m]	Returns the value a (V, L, F, ...) as formatted number with n places and m decimal places

All format specifications can be arbitrarily combined with one another and can only be used on numerical parameters (excluded e.g. special string S and Z, date, time, ...). The multiplication and division calculation apply over the addition and subtraction calculation.

Without format specification the output is left-aligned and the leading zeros are suppressed except in hexadecimal output. They are filled with spaces in format specifications. Should the value exceed the possible number of digits by format specifications, the output is expanded to the required number of digits. The decimal point and possibly an existing sign (only with negative numbers) also occupy a place.

If numbers are used in format string that are not enclosed in quotation marks then they are interpreted as ASCII Code and output as corresponding ASCII characters. Here every ASCII Code must be separated by a space, comma or period.

Example:

SO1Format 72 97 108 108 111	for string 'Hello' and CR LF
SO1Format v 13 10	for velocity and twice CR LF

The standard identifier of the output string is CR LF (13 10 or 0DH 0AH). It can be disabled with the parameter T and it is possible to define the identifier at the end of the format string. The position of the parameter T for disabling the identifier is not relevant. A self-defined identifier must always be at the end of the format string.

Examples:

SO1Format v ' m/s'	Velocity and string m/s, CR LF
SO1Format v,' ',r	Velocity, SPACE, measuring rate, CR LF
SO1Format v 20 r	Velocity, SPACE, measuring rate, CR LF
*SO1Format v*60,' m/min',l,' m'*	Velocity, m/min, length, m, CR LF
*SO1Format l*10+12.345*	Length in dm + offset (specified in dm)
SO1Format s t l:h 10	For special format s, long hexadecimal and LF
SO1Format '#rat'r t42	for string '#rat', measuring rate and characters '*'

The hexadecimal output is preferred if values faster than 20 ms should be given in time grid (see page 62, The command *SO1Time*) since the conversion requires considerably less computing time in hexadecimals. The format S or Z is always used in a time grid < 10 ms.

[17] The hexadecimal output in the format a:H:n takes place with signs (minus signs or spaces) and n decimal places. Every byte requires 2 decimal places. Without the parameter n, 9 characters for 4 bytes and the sign are returned (32 bit number). Leading zeros are not suppressed.

The command *SO1On*

The data output on the serial interface is switched on or off with this command. Data output is interrupted during the command input and processing!

Syntax: ***SO1On*** [n] (n = 0 - off, 1 - on)

The command *SO1Sync*

With this command it is defined whether the output value is sent synchronously to a selectable time interval (see page 62, The command *SO1Time*) or by a trigger event.

Syntax: ***SO1Sync*** [n] (n = 0 - time-, 1 - trigger- synchronous)

The command *SO1Time*

The time interval in ms is defined with this command in which the data is output to the interface S1.

All accumulated values (bursts) are averaged with the velocity measurement during the averaging time (see page 53, The command *Average*) The data is then output equivalently with the time set by *SO1Time*.

Syntax: ***SO1Time*** [n] (n = 1 ... 65535) Unit: ms

The command *Tracking*

The command *Tracking* defines the type of adjustment of the signal processing to the current velocity.

Syntax: ***Tracking*** [n] (n = 0 ... 6, Standard is 2)

Attention should be paid for the correct operation of the measuring device that the direction via the command *Direction* and the maximum plant velocity via the command *Vmax* are set correctly.

The standard is *Tracking 2*. **This *Tracking 2* is suitable for almost all measurement tasks** and is chosen in case of doubt. For special use please take the setting for Tracking from the Table.

Table 8: Parameter for command Tracking

n	Meaning	Typical use
0	Broadband signal processing	Special uses, e.g. measurement with extremely higher acceleration.
1	the velocity at *Vmax* / 8 takes place, up to this point broadband	Continuous measuring with very high acceleration from zero (measuring device accelerated very fast from zero; only for special machining line)
2	tracks the velocity at zero	Single part measuring or continuous measuring but with normal or slow acceleration from zero **Suitable for most measuring tasks** (Measuring object runs with velocity greater than zero one or accelerates from zero)
3	tracks the velocity at *Vmax* / 8, additional search function for bad signals	Continuous measuring for structurally poor, non-metallic surfaces with very high acceleration from zero (only for special machining line for non-metallic surfaces)

n	Meaning	Typical use
4	tracks the velocity at zero, additional search function for bad signals	Continuous processes for structurally poor, non-metallic surfaces with or without start from zero (Measuring object runs with velocity greater than zero one or accelerates slowly from zero; e.g. belt conveyors for plastics and coated materials, rewinder for paper or extruder)
5	Like Tracking 1. Additionally: - tracks a dynamic adjustment of the amount of the minimum period for a valid Burst [1)] - tracks an increase of the broadband if Holdtime begins to expire [2)] - tracks the use of soft Epsilon values in the lower velocity range [3)]	Continuous measurement with extremely high accelerations and delays (measuring device accelerated very fast from zero; only for special machining line)
6	Like Tracking 2. Additionally: - tracks a dynamic adjustment of the amount of the minimum period for a valid Burst [1)] - tracks an increase of the broadband if Holdtime begins to expire [2)] - tracks the use of soft Epsilon values in the lower velocity range [3)]	Single part measurement or continuous measurement with extreme accelerations and delays (only for special machining lines)

[1)] this measure is used if the parameter *Permin* (see page 59) is set accordingly

[2)] this measure is used if the parameter *AMAX* (see page 52) is set

[3)] this measure is used if the parameter *Epsilon* (see page 55) is set accordingly

The command *Trigger*

The command *Trigger* is used for specifying the type of trigger signals together with a length measurement. The object counter increases by one in every trigger event.

Syntax: ***Trig**ger* [n] (n = 0 ... 5)

n	Trigger event at	Voltage level at Input	Use
0	H Level	+10 V to +30 V	single part measuring
1	L Level	0 V to +8 V	single part measuring
2	L/H Edge	low/high edge	continuous measuring
3	H/L Edge	high/low edge	continuous measuring

Single part:

If the signal changes to the active level, the length measuring is started and stopped in the next level change.

Continuous measuring:

It is measured continuously. A trigger edge stops the measuring and triggers the next measuring simultaneously.

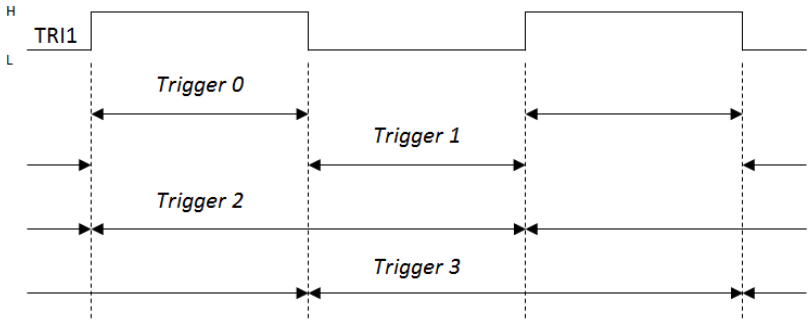


Figure 33: Active length measurement or active trigger signal depending on the command Trigger

The concerned output channel is updated simultaneously with a stop of the length measurement by trigger synchronous (see commands *AOSync, PO1Sync, PO2Sync, PO3Sync, SO1Sync and SO2Sync).*

The command *Vmax*

The maximum plant velocity is set with the command *Vmax* in m/s. It is required, for the best possible functioning, that the value for ***Vmax corresponds exactly to the actualities of the situation***. It should be set neither too high nor too low since otherwise the automatic adjustments do not work properly.

Syntax: ***Vmax*** [f] (n = 0.01 ... 100.00 m/s)

Attention should be paid for the correct operation of the measuring device that the direction over the command *Direction* and the maximum plant velocity over the command *Vmax* are set correctly. Vmax is entered without a sign.

The measuring device may not be operated above the velocity range mentioned in the data sheet, otherwise the proper function cannot be guaranteed. Please note the parameter *Mode* since it affects immediately the maximum allowed velocity. The parameter *Vmax* is set according to the actual maximum plant velocity. A reserve of approx. 10 % is already considered in the device.

The command *Vmin*

The command sets the velocity up to the device suppresses the output (to field bus, analog output, pulse output) of the velocity. If the value of VMIN is undershot during a running measurement, the outputs will be closed regardless the value of Holdtime (see 57, The command *Holdtime*). The value is in m/s without a sign. The signal LED lights yellow, when the VLM500 detects a velocity but VMIN is still undershot. If VMIN is set to zero, this functionality is turned off. The standard value is 0.

Syntax: ***Vmin****x* [f] (n = 0 ... 100.00 m/s)

While entering a value for VMIN, the device checks if the value is greater or lower than VMAX. If necessary, is shows an error message.

The command *Window*

The parameter Window was implemented for highly dynamic velocity measurements in production process and for feedback control problems. This calculates the weighed moving average according to signal quality over the frequency of the individual burst. A ring memory with 2 to 32 averaging cycles is used (see Figure 1). The duration of a cycle is represented in Figure 1 as a section and corresponds to the averaging time *Average.* The incoming single values are added asynchronously, the outcome is read synchronously once per *Average.* Thereby, a high refresh rate of up to 32 times can be achieved to the outputs against the normal average.

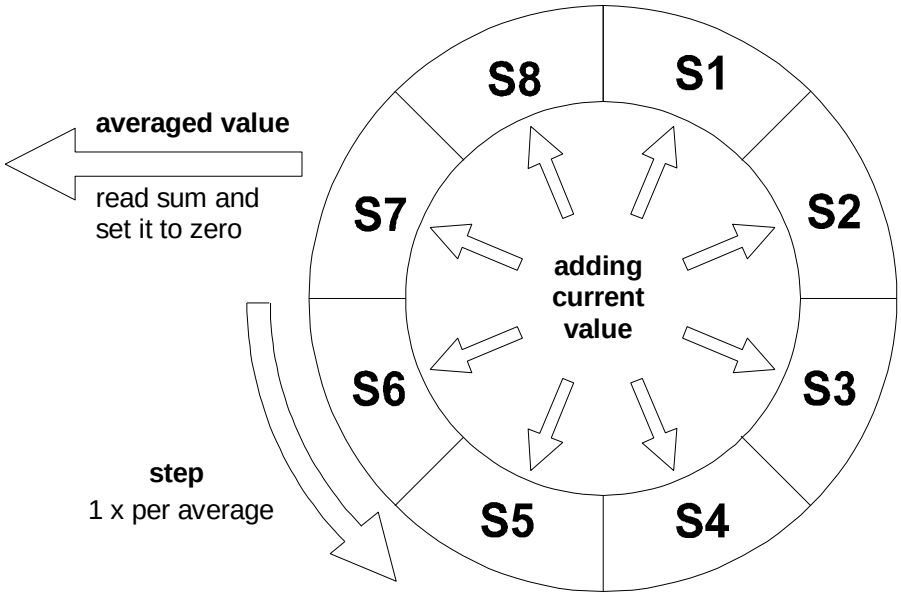


Figure 1: Simplified operating principle of the averaging processor with 8 cycles[18]

The averaging time (see page 53, The command *Average*) is chosen as high as the desired updating time for the fastest used output channel.

The sliding averaging can be switched off with the command *Window 1*.

Syntax: ***W**indow* [n] (n = 1 ... 32)

11.7 Legally relevant commands

Command	Description	Syntax
Password	The system command Store is protected by a password that can be changed with the command Password. The password consists of up to eight characters including letters, digits, special and blank characters that are represented by stars during input. Upper- and lower-case letters are not distinguished. The password protection can be switched off in which no characters are entered upon requesting the new password and is confirmed with 'Enter'. A cancellation of the input can be made with 'ESC'. The label 'Illegal use!' appears with three incorrect inputs of the password. Afterwards, a period of 60 seconds must be waited before the next command is accepted. The password '**WEGA**' is preset.	***Pas**sword*

[18] *Window 8*, that is 8 sliding windows (sum S1 to S8)

Command	Description	Syntax
Restart	A restart of the device is triggered with this command. The parameter is thereby reset with the *Store* command to the last saved values.	***Resta**rt*
Restore	This command loads the specified parameter set from the stated storage place to the main memory of the VLM. Thereby, the current unsaved changes are lost. When the device is restarted (via command “restart” or by interrupting the power supply) this command is executed automatically. The parameter set which is loaded during restart depends on: - the parameter set which was loaded the last time when calling the command restore or - the last stored parameter set when calling store. When the command is executed without specifying a storage place, the parameter set from storage place 0 is loaded. Calling “restore f” loads the factory default settings. To work with this parameter set, it needs to be stored in a storage place. The factory default settings cannot be overwritten by the user. Options: n = 0, 1, 2, 3, 4 – Definition of the parameter set to be loaded n = f – loading of factory default settings	***Resto**re* [n] [s]
Start	The effect of the command Start depends on the command Trigger which defines if a single part measurement or a continuous measurement takes place. The integration of the length is started with single part measurement beginning at the length value zero. The integration of the length is stopped with continuous measurement and restarted simultaneously.	***Sta**rt*
Stop	The effect depends on the command *Trigger*. The integration of the length is only stopped with the single part measurement.	***Sto**p*
Store	The command saves the actual parameters in the device permanently. This parameter set is retained after a power off or a restart of the device. Up to five parameter sets can be stored in the VLM. The last saved parameter set is reloaded after powering on the device. The command is protected with a password. When the device is restarted a parameter set is loaded automatically. The decision which set out of the five sets is loaded depends on: • the parameter set which was loaded the last time when calling the command restore or • the last stored parameter set when calling this command. When the command is executed without specifying a storage place, the parameter set from storage place 0 is loaded. Options: n = 0, 1, 2, 3, 4 – Definition of storage place	

Command	Description	Syntax
Update	The command changes a parameter in the boot loader without specification. An update of the Firmware of the device can take place in the boot loader. The boot loader indicates the required steps. The command must be written out. Options: n = 0 – Update of ADSC, 1 – Update SLOT4, 2 – Update SLOT5, 3 – Update SLOT6  It is strongly recommended to use the VLMTool for an update. This guarantees an error-free implementation.  The VLM500 must not be switched off during the update. The VLM500 will restart automatically when the process is complete.  If the update fails and the firmware is damaged, the device may no longer start. In this case, contact the manufacturer.	***Update*** [n]

11.8 Non-legally relevant parameter

The parameters that are not legally relevant are parameters that do not affect the recording of measured values.

11.8.1 Analog output

An analog current value can be output with an analog output (optional extension card IAUN). A digital/analog converter is used. The range for the output of the measured values is set with the commands *AOMin* and *AOMax*. *ANMin* sets the value with which the minimum current value is output. *AOMax* applies accordingly to the maximum value.

Example: The following value pairs result from *AOMin = 0* and *AOMax = 100*:

Current value	*AOValue V* Velocity	*AOValue R* Measuring rate	*AOValue Q* Signal quality in movement	*AOValue Q* Signal quality during standstill
4 mA	0 m/s	0	Measuring rate = 0	little reflection
12 mA	50 m/s	50	Measuring rate = 50	medium reflection
20 mA	100 m/s	100	Measuring rate = 100	a lot of reflection

The lowest current value is output if the actual measuring value is lower than *AOMin* and the highest current value is output if it is greater than *AOMax*. The output value is parameterizable. The output is updated either after achieving *Average* or after a Trigger event.

Example for analog output

The output 4 to 20 mA in a velocity range of -3 to +3 m/s with different values for *AOMIN* and *AOMAX* is represented in the following diagram. The velocity at the analog output is given out (*AOValue V*).

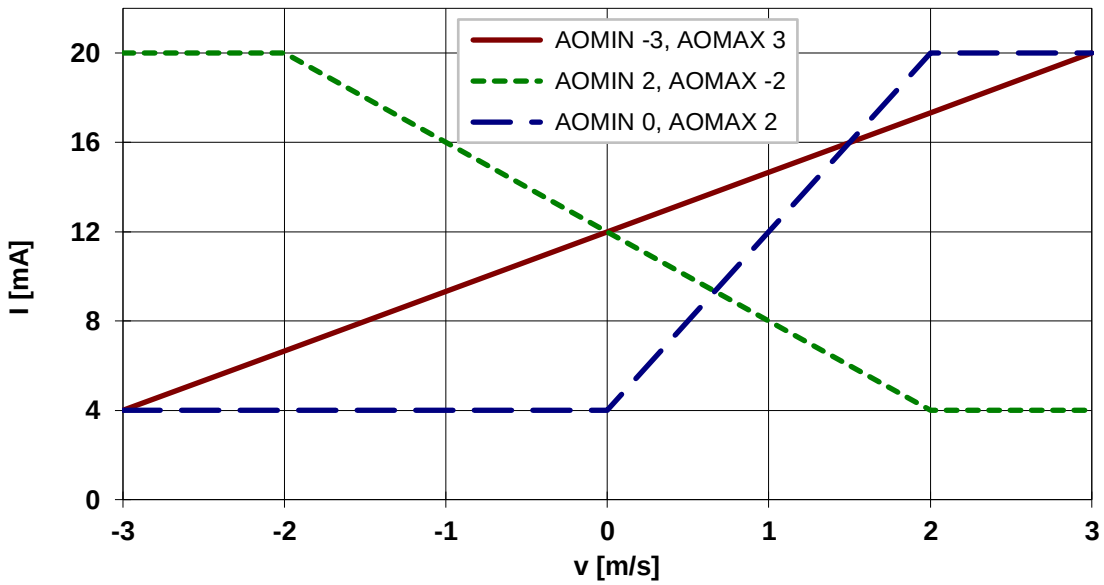


Figure 34: Examples for analog output

> Currents lower or higher than the range determined by the hardware (e.g. 4 to 20 mA) are not possible. If e.g. the output value exceeds *AOMAX*, the maximum current value is put out.

The command *AOMax*

The maximum value for analog outputs is determined with this command.

Syntax: ***AOMax*** [f] (n = -1000.0 ... 1000.0)

Depending on the parameter *DIRECTION* it may be necessary to adjust the value for AOMAX for a negative value, if the device is assembled backwards to the direction of movement.

The command *AOMin*

With this command, the minimum value for analog output can be set.

Syntax: ***AOMin*** [f] (n = -1000.0 ... 1000.0)

The command *AOOn*

With this command, the analog output is switched in or off.

Syntax: ***AOOn*** [n] (n = 0 - off, 1 - on)

The command *AOSync*

With this command is specified if the output value is updated synchronously with the indicated time interval *Average* (see page 53, The command *Average*), during a trigger event (see page 63, The command *Trigger*) or during every burst.

Syntax: ***AOSync***[n] (n = 0 - average-, 1 – trigger- synchron)

The command *AOValue*

With this command is determined if the Velocity, the measuring rate or the signal quality shall be output.

Syntax: ***AOValue*** [c] (c = 'V', 'R', 'Q')

If option *AOValue Q* is set, the measuring rate (like at *AOValue R*) is output during the measurement and in case of signal failure or standstill of the measuring object the product (Quality) out of light brightness and exposure time (Exposure) at the analog output. This function can be used as alignment aid for pipe and wire applications.

11.8.2 Commands for pulse output 1

During the pulse output, two clock sequences A and B (maximum deviation of the phase ± 10°) displaced for 90° with a duty cycle of 1:1 at the outputs OUT1 and OUT2 are provided. The phase shift can be controlled by the direction input 'DIR' or the optional internal direction recognition of +90° to -90°.

The output is updated either after reaching *Average* or after a trigger.

The command *PO1Factor*

With this command, a scaling factor can be set up. The factor 1 corresponds to an output frequency of 100 Hz, if the velocity 0.1 m/s or the measuring rate is 100 (see also page 70, The command *PO1Value*). For the velocity the unit of this scaling factor is **pulses per millimeter**.

Syntax: ***PO1Factor*** [f] (n = -2500.0 ... 2500.0, <> 0)

The minimum possible output frequency for the pulse output is 0.2 Hz. If the output value is lower, no pulses are output! The maximum possible output frequency depends on the installed interface boards and their output wiring.

The command *PO1Hold*

The command allows freezing the first pulse output depending on the inputs DIRECTION or TRIGGER 1, irrespective of a current measurement or a signal dropout. Alternatively, a hold time between 1.0 s and 25.5 s can be adjusted in steps of 100 ms. This allows holding the last valid measuring value at the first pulse output in case of signal dropout over a hold time in addition to *Holdtime* (see page 57, The command *Holdtime*). Still, the output, different from the control via the inputs DIR or TRI1, must be updated as soon as new measuring values are available.

Syntax: ***PO1H**old* [n] (n = 0 ... 4, 10 ... 255)

n	Holding pulse output	Voltage level
0	Off	-
1	at H level to DIR	high: +10 V to +30 V
2	at H level to DIR	low: 0 V to +8 V
3	at H level to TRI 1	high: +10 V to +30 V
4	at L level to TRI 1	low: 0 V to +8 V
10...255	for 1.0 s ... 25.5 s in 100 ms steps	-

The command *PO1On*

With this command, the pulse output is switched on or off.

Syntax: ***PO1On*** [n] (n = 0 - off 1 - on)

For minimizing the processor load, unused output channels must be switched off!

The command *PO1Output*

With this command, the output type of the second phase of the first pulse output is determined.

Syntax: ***PO1Ou**tput* [n] (n = 0 - A+B, 1 - A+DIRECTION)

The command *PO1Sync*

With this command is determined if the output value is updated synchronously with the given time interval *Average* (see page 53, The command *Average*) or during a trigger event (see page 63, The command *Trigger*).

Syntax: ***PO1S**ync* [n] (n = 0 - average-, 1 – trigger- synchronous)

The command *PO1Value*

With this command is determined if the velocity, the measuring rate or the signal quality are output.

Syntax: ***POC1V**alue* [c] (c = 'V', 'R', 'Q')

If option *PO1Value Q* is set, the measuring rate (like at *PO1Value R*) is output during the measurement and in case of signal failure or standstill of the measuring object the product (Quality) out of light brightness and exposure time (Exposure) at the pulse output. This function can be used as alignment aid for pipe and wire applications.

11.8.3 Commands for pulse output 2 and 3

The VLM500 can be quipped up to three pulse outputs. Each pulse output has its own parameter group. For output 1 the parameters are explained in chapter 11.8.2.

For output 2 and 3 the parameters and their meanings are the same. Except the name differs.

PO1FACTOR → PO2FACTOR, PO3FACTOR
PO1HOLD → PO2HOLD, PO3HOLD etc.

11.8.4 Commands for serial interface 2 (Process data output)

The Command *SO2Format*

The process data interface must be programmed to a specific format so that the process data can be correctly transferred from the fieldbus interface.

Syntax: ***SO2F**ormat [s]* (s – String of parameters, max. 42 character)

The Command *SO2Interface*

The serial interface is configured with this command. There is the setting of baud rate, protocol type, parity and directionality. The setting can take place individually for each parameter or simultaneously for all parameters. The order of the parameters does not matter. Unspecified parameters are not changed. The format is set with eight data bits and a stop bit. With parity enabled, the eight data bit is replaced by the parity bit.

Syntax: ***SO2I**nterface* [n] [c] [c] [c] (n = baud rate, c = protocol, parity, ...)

The following values are possible for the baud rate:

n: 9600; 19200; 38400; 57600; 115200

C	Description
	Protocol type
'-'	No protocol
'X'	Software protocol (XON / XOFF Codes)
	Parity
'N'	No parity
'O'	Odd parity
'E'	Even parity
	Directionality
'D'	Duplex
'H'	Half-duplex

The command *SO2On*

The data output on the serial interface is switched on or off with this command. Data output is interrupted during the command input and processing!

Syntax: ***SO1On*** [n] (n = 0 - off, 1 - on)

The command *SO2Sync*

With this command it is defined whether the output value is sent synchronously to a selectable time interval (see page 62, The command *SO1Time*) or by a trigger event (see page 63, The command *Trigger*).

Syntax: ***SO2Sy****nc* [n] (n = 0 - time-, 1 - trigger- synchronous)

The command *SO2Time*

The time interval in ms is defined with this command in which the data is output to the interface process data output. All accumulated values (bursts) are averaged with the velocity measurement during the averaging time (see page 53, The command *Average*) The data is then output equivalently with the time set by *SO2Time*.

Syntax: ***SO2T****ime* [n] (n = 1 ... 65535) Unit: ms

11.9 Non-legally relevant commands

The VLM500 has a number of corresponding test commands to examine the measurement behavior, to analyze the hardware installed in the VLM500 or to generate test signals. If the VLMTool is used, the test commands are shown in separate windows with display instruments.

Command	Description	Syntax
Leave	By calling this command, the communication channel to the VLM500 that was previously set up (CDB command %COMVLM) is eliminated. The entire VLM500-MID is restarted.	***Leave***
Savenlp	The command only saves the non-legally relevant parameters permanently in the device. The non-legally relevant parameters are inserted into the parameter set last selected by the Store or Restore command. The command is protected by the password set by the command PASSWORD.	***Savenlp***
Standby	The command is used in order to set the device in Standby mode. The measuring function is set and the light source is switched off. The cancellation of the Standby Mode takes place with ESC. After at most 500ms the VLM500 is ready for measuring.	***Stan****dby*
TestAO	A row of values is displayed that gives information about the function of the analog output. The following values are constantly displayed: velocity, measuring rate, output current in percentage and load (LOAD). If no load (500 Ohm maximum) is connected or no interface card with analog output is installed, then the value for LOAD is 0. The refresh of the display is every 250 ms. The data output is interrupted	***TestA****O* [c]

Command	Description	Syntax
	during the test commands! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	
TestFilter	A row of parameters and values is displayed that have effects on the filter board or give information about their function. The following values are displayed: frequency, velocity, measuring rate, center frequency of the filter board, broadband, conditions: bandpass/upper low pass/upper low pass and anti-alias field. The refresh of the display is every 250 ms. The data output is stored during the test command! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	***TestF**ilter* [c]
TestIO	A row of values is displayed that give information about the function of the system. The following values are displayed: velocity, length, measuring rate, the outputs TRI1, TRI2, DIR, STBY and also the outputs ERR and STAT. The refresh of the display is every 250 ms. The data output is interrupted during the test command! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	***TestI**O* [c]
TestMeasure	A row of values is displayed that give information about the function of the system. The following values are permanently displayed: frequency, velocity, length, measuring rate, number of periods, exposure time, lamp intensity, overexposure, underexposure and FIFO fill level. The refresh of the display is every 250 ms. The data output is locked during the test command! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	***Testm**easure* [c]
TestPS	A row of values is displayed that give information about the function of the power supply and illumination (LED). The following values are constantly displayed: LED brightness, LED current, LED voltage, 12 V and -12 V supply voltage. The refresh of the display is every 250 ms. The data output is interrupted during the test command! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	***TestP**S* [c]
TestQuality	A bar chart is displayed that gives information about the measuring rate of the signals during the measurement. In standstill, on the other hand, a product (Quality) from lamp brightness and exposure time is displayed instead of the measuring rate. This product can therefore be used, for example, in order to exactly align the VLM500 to a tube or wire. It should be considered here, however, that the length of the bar is the maximum in the movement (measuring rate) and reaches its maximum value (Reflection) in standstill 2/3. This guarantees that a sufficient amount of light is reflected back to the VLM500 from the measuring object. The refresh of the display is every 250 ms. The data	***TestQ**uality* [c]

Command	Description	Syntax
	output is interrupted during the test commands. The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	
TestComp	Important data of the temperature compensation is displayed constantly. The refresh of the display is every 250 ms. The data output is locked during the test command! The test stops after 60 s or by pressing ESC. Option: c – The test doesn't stop after 60 s.	***TestT****Comp* [c]
Simulation	The command is used for simulating velocity and measuring rate at the outputs of the measuring device. It interrupts the actual measurement! The device behaves outwardly as it was set over the parameters of the individual interfaces. Likewise, it reacts from trigger signals applied externally and calculates a length on the basis of the set velocity. The parameter for the velocity must be specified. However, the second parameter for the measuring rate is optional. The abortion of the simulation is made with ESC. Options: f = -100.0 ... 100.0; velocity in m/s n = 0 ... 100; measurement rate	***Si****mulation* [f] [n]
Video	With this command, the operation mode of the device sensor (CDD) can be switched to image recording. This function is used for device inspections by the manufacturer. A specific adapter cable is needed for connecting it to an oscilloscope. The measuring function is deactivated in this mode!	***Vi****deo*

12 Commands and parameters of the CDB

All commands that have a direct effect on the CDB begin with a percent sign "%". If a parameter of the CDB is changed (regardless of whether it is legally relevant or non-legally relevant), it is automatically stored permanently. There is no separate save command.

With the VLM500, after changing one or more parameters, the *STORE* or *SAVENLP* command must be called in order to save the changes permanently.

12.1 Legally relevant commands and parameters

Command: %date

The command is used to set the date of the internal clock of the CDB. It is important to set the date, since every saved data set is provided with the current date of the CDB. The date must be set correctly for traceability of length measurement values.

Syntax: **%date** [dd/mm/yyyy] example: %date 21/02/2020

If the automatic changeover between summer and winter time is activated, a check is made when the date is changed to determine whether the date entered falls within summer or winter time.

Command: %deletenvm

The command deletes all stored data records from the non-volatile memory. The call must be made with the option *a*. Otherwise the call will be ignored.

Syntax: **%deleten**vm a

Deleting all data sets via the user interface is also possible.

Command: %duration

The command sets the amount of days a dataset cannot be overwritten.

Syntax: **%duration** [n] n: 0… 252 example: %duration 120

For the German legal area legal measurements must be kept for at least 90 days. This requirement may differ in other countries.

Command: %overwrite

The command specifies whether data records can be overwritten, if they are older than 90 days and the total memory is completely occupied.

Syntax: **%overwr**ite [y,n] example: %overwrite n (do not overwrite)

Command: %time

The command is used to set the date of the internal clock of the CDB, as well as to activate or deactivate the automatic changeover between summer and winter time. It is important to set the time, since every saved data record is provided with the current time of the CDB. The time must be set correctly for the traceability of length measurement values.

Syntax: **%time** [hh:mm:ss] [n] example: %time 08:45:31

The parameter [n] is optional. With n = 1, the automatic changeover from winter to summer time or summer to winter time is activated. With n = 0 this automatic is switched off.

If the automatic changeover between summer and winter time is activated, a check is made when the time is changed to determine whether the time entered falls within summer or winter time.

Command: %unit

The command specifies in which unit the measured length values are displayed and saved. The available options are meters (m) and kilometers (k).

Syntax: **%unit** [m,k] example: %unit m (set meter as length unit)

Command: %update

The %update command changes to the bootloader area of the CDB. Now an update of the CDB firmware is possible. The boot loader shows the necessary steps.

Syntax: **%update**

Any update of the firmware shall be made with the VLMTool!

The CDB must not be switched off during the update. The CDB will restart automatically when the process is complete.

If the update fails and the firmware is damaged, the device may no longer start. In this case, contact the manufacturer.

12.2 Non-legally relevant commands and parameter

The Command %additionalunit

This command can be used to parameterize the length unit of the additional length display in the measurement display.

Syntax: **%addi**tionalunit [n] (0, 1, 2, 3, 4) example: %additionalunit 2

The following units are available:

0 … <no additional length display >, 1 … meter, 2 … kilometer, 3 … inch, 4 … feet

The original length value is converted into the length unit selected.

The Command %article1

The command is used to set the character string “Article1”. This character string is printed on the label and is stored in the data set. The string can be a maximum of 20 characters long. Umlauts and spaces are not permitted. This parameter can be used, for example, to enter an article number.

Syntax: **%article1** [<s>] example: %article1 B1000024K6

Note: This command sets the standard setting for Article1, which is retained even after the device is restarted. The setting is temporarily overwritten if the value is changed via the data output interface.

To delete the setting (no character string) “%article1 !” must be called.

The Command %article2

The command is used to set the character string “Article2”. This character string is printed on the label and is stored in the data set. The string can be a maximum of 20 characters long. Umlauts and spaces are not permitted. This parameter can be used, for example, to enter an article number.

Syntax: **%article2** [<s>] example: %article2 F10A002646

Note: This command sets the standard setting for Article2, which is retained even after the device is restarted. The setting is temporarily overwritten if the value is changed via the data output interface.

To delete the setting (no character string) “%article2 !” must be called.

The Command %article3

The command is used to set the character string “Article3”. This character string is printed on the label and is stored in the data set. The string can be a maximum of 20 characters long. Umlauts and spaces are not permitted. This parameter can be used, for example, to enter an article number.

Syntax: **%article3** [<s>] example: %article3 455636526475

Note: This command sets the standard setting for Article3, which is retained even after the device is restarted. The setting is temporarily overwritten if the value is changed via the data output interface.

To delete the setting (no character string) “%article3 !” must be called.

The Command %company

The command is used to set the character string “Company”. This character string is printed on the label and is stored in the data set. The string can be a maximum of 20 characters long. Umlauts and spaces are not permitted.

Syntax: **%company** [<s>] example: %company ASTECH-GmbH

Note: This command sets the standard setting for Company, which is retained even after the device is restarted. The setting is temporarily overwritten if the value is changed via the data output interface.

To delete the setting (no character string) “%company !” must be called.

The Command %errorlevel

The command changes the switching behavior of the switching output 'ERROR'.

Syntax: %***Error****level* [n] (0, 1)

0 = 'ERROR' active when no error is pending, passive in case of an error condition

1 = 'ERROR' aktive in case of an error condition, passive when no error is pending

If the VLM500-MID is switched off, the 'ERROR' output is always passive (open).

The Command *%info*

When this command is called, information is output via the VLM500-MID. After switching on the VLM500-MID, the information is automatically output to the service interface.

Syntax: **%info**

The Command %machine

The command is used to set the character string “Machine”. This character string is printed on the label and is stored in the data set. The string can be a maximum of 20 characters long. Umlauts and spaces are not permitted. This parameter can be used, for example, to enter an article number.

Syntax: **%machine** [<s>] example: %machine ASTECH-VLM

Note: This command sets the standard setting for Machine, which is retained even after the device is restarted. The setting is temporarily overwritten if the value is changed via the data output interface.

To delete the setting (no character string) “%machine !” must be called.

The Command %mode

The command is used to set the measurement sequence. If the length is measured manually (manual confirmation and resetting of the length), [m] must be set. [T] must be set for the triggered measurement sequence or an automated confirmation of the length.

Syntax: **%mode** [m,t] example: %mode m (manual sequence)

The Command *%parameter*

By calling this command, all parameters and their set values are output. This is used for the clear presentation of the current parameterization. Calling this command does not change any parameters.

Syntax: **%para**meter

The Command %presetlength1

This command can be used to define the first preset length (Preset Length approached). The entry is made in the unit meter. If the counter has reached or exceeded the value of preset length 1, the associated switching output switches.

Syntax: **%presetlength1** [f] (f = 0.00 ... 100.000,00) example: %presetlength1 23.50

The Command %presetlength2

This command can be used to define the first preset length (Preset Length reached). The entry is made in the unit meter. If the counter has reached or exceeded the value of preset length 2, the associated switching output switches.

Syntax: **%presetlength2** [f] (f = 0.00 ... 100.000,00) example: %presetlength2 23.50

It is recommended to set Presetlength 1 smaller than Presetlength 2!.

The Command *%printdoc*

The command defines whether a label should be printed out automatically with each completed length measurement (a) or not (m). In the latter case printing is done by user call.

Syntax: **%print** [a,m] example: %print m (no automatic print out)

The Command *%restart*

The command restarts the VLM500-MID. A running length measurement is aborted by a restart.

Syntax: **%restart**

The Command *%readdata*

The command enables the stored measured values to be read out via the programming interface. The datasets are not changed when reading out. The user has the option of reading out all data sets or just a certain part. To read all datasets option 'a' must be called. This operation cannot be canceled. Be careful with large amounts of data!

By specifying two numbers n1 and n2, the data records from n1 up to and including n2 can be output.

Syntax: **%readdata** [a, <n1, n2>] example: %readdata 3 67 (reads out dataset 3 to 67)

The output in ASCII characters is separated by semicolons.

The Command *%SO3Interface*

The printer connection is configured with the%SO3Interface command. The baud rate, the protocol type, the parity and the directional dependency are set. The setting can be made for each parameter individually or for all parameters at the same time. The order of the parameters does not matter. Parameters not specified are not changed. The format is defined with eight data bits and one stop bit. When parity is switched on, the eighth data bit is replaced by the parity bit.

Syntax: %***SO3In****terface* [n] [c] [c] [c] (n = baud rate, c = protocol, parity, ...)

The following values are possible for the baud rate:

n: 9600; 19200; 38400; 57600; 115200

C	Description
	Protocol type
'-'	No protocol
'X'	Software protocol (XON / XOFF Codes)
	Parity
'N'	No parity
'O'	Odd parity
'E'	Even parity
	Directionality
'D'	Duplex
'H'	Half-duplex

The Command *%SO4Interface*

The optional data output interface is configured with the%SO4Interface command. The baud rate, the protocol type and the parity are set. The setting can be made for each parameter individually or for all parameters at the same time. The order of the parameters does not matter. Parameters not specified are not changed. The format is defined with eight data bits and one stop bit. When parity is switched on, the eighth data bit is replaced by the parity bit.

Syntax: %***SO4In****terface* [n] [c] [c] (n = baud rate, c = protocol, parity, ...)

The following values are possible for the baud rate:

n: 9600; 19200; 38400; 57600; 115200

C	Description
	Protocol type
'-'	No protocol
'X'	Software protocol (XON / XOFF-Codes)
	Parity
'N'	No parity
'O'	Odd parity
'E'	Even parity

13 Technical data

VLM500

	VLM500A	VLM500D	VLM500L	VLM500E
Nominal distance and working range	185 ± 15 mm	240 ± 15 mm	185 ± 10 mm	330 ± 30 mm
- extended working range [1]	185 ± 15 mm	240 ± 30 mm	185 ± 15 mm	330 ± 30 mm
Measuring range	0.60 … 2200 m/min	0.18 … 1200 m/min	0.12 … 250 m/min	0.60 … 2000 m/min
- in extended working range	1.20 … 3000 m/min	0.72 … 2400 m/min	0.30 … 600 m/min	1.00 … 2700 m/min
- with special filter FB2V	0.35 … 280 m/min	0.18 … 150 m/min	0.08 … 100 m/min	0.41 … 270 m/min
- in extended working range and FB2V	0.75 … 570 m/min	0.42 … 330 m/min	0.25 … 200 m/min	0.82 … 540 m/min
Measuring uncertainty [1]	< 0.025 % at nominal working distance < 0.05 % in working range and < 0.2 % in extended working range			
Reproducibility [1]	< 0.025 %			
Detector / principle	CCD sensor / spatial filter with semiconductor grid as reference			
Illumination	White light LED (expected life span: > 5 years)			
State indicator (LED in cover plate)	Signal (green), Error signal (red), Communication (yellow), Forward(green), Backward (green)			
Power supply, consumption	24 VDC, max. 25 W			
Temperature range	0 °C … 50 °C			
Protection class	IP 65			
EMC	compliance with EN 61326-1 (group 1, class A) Emission: CISPR 11, Susceptibility: IEC 61000-4-2, -3, -4, -5, -6			
Weight, Housing dimensions	approx. 3.6 kg, 260 mm x 160 mm x 90 mm (without connections)			
Pulse output / Encoder (optional)	A/B, 2 phases 90°, resolution 8 ns, 0.2 Hz … 25 kHz or 0.2 Hz … 1 MHz Optionally as Open Collector (IPPL), 5V [2] active (IP5V) or Push Pull (IPPP) [2]			
Analog output (optional)	Current output, adjustable as 0 … 20 mA, 0 … 24 mA, 4 … 20 mA (IAUN)			
Process data interface (optional)	Field bus: Profinet IO (IFPN), EtherNet/IP (IFEI), Ethernet (IFFE)			
Standard scope of delivery	VLM500, Power supply cable, Connection cable, positioning aid			

[1] DIN 1319 / ISO 3534, of measured length, test conditions: measuring length 10 m, active tracking, constant conditions in: temperature (20 °C), distance, velocity, illumination.

[2] IP5V and IPPP provide output frequencies up to 2 MHz.

CDB

Display	240 x 128 Pixel, background illuminated
Keys	4x, soft keys
Memory capacity	3,938,304 (overwritable after 90 days)
Storable length	0 m < … < 100,000.00 m or 0.01 km < … < 500,000.00 km (legally valid from 10 m)
Print output	Brother TD-4000 (EPSON ESC/POS® protocol)
Length measurement	Auto trigger, manual via key, cut to length according preset length
Programming decontrol	Dongle
State indicator	Signal (green) or Error signal (red)
Power supply, consumption	24 VDC, max. 5 W, power supply via cable from VLM500
Temperature range	0 °C … 50 °C
Protection class	IP 64
EMC	compliance with EN 61326-1 (group 1, class A) Emission: CISPR 11, Susceptibility: IEC 61000-4-2, -3, -4, -5, -6
Weight, Housing dimensions	approx. 1,8 kg, 160 mm x 160 mm x 91 mm (without connections)
Programming interface	for parameter setting and firmware update: USB as virtual COM-Port, isolated
Data output (optional) (protocol interface)	Field bus: Profinet IO (IFPN), EtherNet/IP (IFEI), Ethernet (IFFE) Serial: USB (IUSB), RS-232 (I232), RS-422/RS-485 (I4UN), isolated
Signal Input	External trigger, external direction (Open collector, isolated and short circuit proof)
Signal output	Error, Status, 2x preset length (Open collector, isolated and short circuit proof)
Standard scope of delivery	CDB, cable for programming interface (USB), connection cable to VLM500, programming adapter, USB memory with documentation and software, printed manual

14 Appendix

14.1 Parameter overview VLM500

Legally relevant parameter

Table 9: Legally relevant VLM500 parameter

Command	Explanation	unit	range	Presetting
Amax	Acceleration range	m/s^2	0… 10	0
***Am**plifier*	Signal amplification	-	0 ... 3 - fix a - Automatic	4
***Av**erage*	Averaging time	ms	0 or 0.2 ... 10000	30 ms
Bw	Bandwidth	%	a - Automatic 10 ... 75	0
***Calf**actor*	Calibration factor	-	0.950000 ... 1.050000	1.000000
***Cali**brate*	Calibration c, n, f c -Velocity or length n -Measuring time in s / Number f - Calibration value m/s o. m		 V, L 1 ... 65535 0.0001 ... 10000	-
***Cl**ock*	Display and setting of internal time	-	hh:mm:ss	-
***Controlh**old*	Holding the control circuits (only for single item measurements)	-	0 - off 1 - on	0
***Cont**roltime*	Control period in case of underload	s	0.01 ... 1.00	0.1
***Da**te*	Display and setting internal date	-	dd.mm.yy	-
***Ep**silon [f][c]*	f= Percent deviation of the periods c= Activation of the 2nd Epsilon table	%	a - Automatic 0.787 ... 50.0 0 - off 1 - on	0 0
***Expo**sure*	Exposure time	-	0 ... 14 - fix a – Automatic	15
***Expma**x*	Maximum exposure time during control	-	0 ... 14 - fix a – Automatic	15
***Expmi**n*	Minimum exposure time during control	-	0 ... 14 - fix a - Automatic	15
***Di**rection*	Direction of object movement	-	0 - forward 1 - backward 2 – forward, extern 3 – backward, extern a - Automatic	0
***Ho**ldtime [n1][n2]*	n1= Hold time n2= Reaction time	ms	10 ... 65535 9 ... 65534	250 ms -
***Illu**mination*	Intensity of the LED	-	0 ... 30 - fix a - Automatic	31
***Illma**x*	max. LED intensity during control	-	0 ... 30	30
***Illmi**n*	min. LED intensity during control	-	0 ... 30	0
***Length**offset*	Sets the offset value for a length measurement	m	0 … 999,9999	0

Command	Explanation	unit	range	Presetting
***Minr**ate*	Monitoring measurement rate	-	0 - off, 1 ... 99 – on	0
Mode	Switching grating constant	-	0 - single, 1 - double	0
OED	Fast overexposure recognition	-	0 - off 1 - on	0
***Perma**x*	Maximum permissible number of periods	-	a - Dynamic 16, 32, 64, 128 – fix	0
***Permi**n [n1][n2]*	n1= Minimum permissible number of periods n2= Minimum permissible number of periods for dynamic period adaptation	-	a - Automatic 2 ... 15 – fix 2 ... 15 – fix	0 -
***Ratei**nterval*	Average time for rate calculation	ms	5 … 100	5
***SensL**evel*	Sensitivity of the period duration measuring device	-	0 ... 3	1
***SO1F**ormat*	Output style	-	See chapter	-
SO1On	Output activation	-	0 - off 1 – on	0
***SO1S**ync*	Output dependency	-	0 - time 1 - trigger	0
***SO1T**ime*	Output interval	ms	1 ... 65535	500 ms
***Tra**cking*	Type of signal processing	-	0 ... 6 (see chapter)	2
***Trig**ger*	Trigger	-	0 - H-level 1 - L-level 2 - L/H-edge 3 - H/L-edge	0
***Vma**x*	Maximum object velocity	m/s	0.01 ... 100.00	4.0
***Vmi**n*	Lower output level of length and velocity data	m/s	0 ... 100.00	0
***W**indow*	Window length (averaging)	-	1 ... 32	8

Non-legally relevant parameter

Table 10: Non-legally relevant VLM500 parameter

Command	Description	unit	range	Presetting
AOMin	Minimum value	-	-1000.0 ... 1000.0	0.000
AOMax	Maximum value	-	-1000.0 ... 1000.0	1.000
AOOn	Analog output activation	-	0 - off 1 - on	0
AOSync	Output control	-	0 – average synchronous 1 – trigger synchronous	0
AOValue	Output value	-	V - Velocity R – Measuring rate Q - Quality	V
PO1Factor	Pulse output scaling factor	-	-2500.0 ... 2500.0	1
PO1On	Pulse output activation	-	0 - off 1 - on	1
PO1Output	Output type of the second phase	-	0 – A + B 1 – A + direction	0
PO1Sync	Output control	-	0 – average synchronous 1 – trigger synchronous	0
PO1Value	Output value	-	V - Velocity R – Measuring rate Q - Quality	V
PO2Factor	Pulse output scaling factor	-	-2500.0 ... 2500.0	1
PO2On	Pulse output activation	-	0 - off 1 – on	1
PO2Output	Output type of the second phase	-	0 – A + B 1 – A + direction	0
PO2Sync	Output control	-	0 – average synchronous 1 – trigger synchronous	0
PO2Value	Output value	-	V - Velocity R – Measuring rate Q - Quality	V
PO3Factor	Pulse output scaling factor	-	-2500.0 ... 2500.0	1
PO3On	Pulse output activation	-	0 - off 1 - on	1
PO3Output	Output type of the second phase	-	0 – A + B 1 – A + direction	0
PO3Sync	Output control	-	0 – average synchronous 1 – trigger synchronous	0
PO3Value	Output value	-	V - Velocity R – Measuring rate Q - Quality	V
SO2Interface	Setting of process data interface	-	See chapter	57600 N X D
SO2Format	Output format	-	See chapter	Z L:H U:H:2 H:H:2
SO2On	Output activation	-	0 - off 1 – on	0
SO2Sync	Output control	-	0 - time 1 - Trigger	0
SO2Time	Output interval	ms	1 ... 65535	500 ms

14.2 Parameter overview CDB

Legally relevant parameter

Table 11: Legally relevant CDB parameter

Command	Description	unit	range	Presetting
%date	Setting of date of CDB	-	-	Central European Summer Time (CEST)
%duration	Setting of time period, a data set is not overwritten	day		90
%overwrite	Setting to overwrite dataset when memory full	-	y, n	n
%time	Setting of time of CDB	-	-	Central European Summer Time (CEST)
%unit	Setting of unit of measured lengths	-	m (Meter) km (Kilometer)	m

Non-legally relevant parameter

Table 12: Non-legally relevant CDB parameter

Command	Description	unit	range	Presetting
%presetlength1	Setting of first preset length output	m	0… 100.000,00	0
%presetlength2	Setting of second preset length output	m	0… 100.000,00	0
%printdoc	Setting of automatic label print after length measurement	-	a – on m – off	m
%errorlevel	Behavior of error output	-	0 – active if no error 1 – active in case of error	0
%mode	Setting of working mode	-	a – automatic m - manual	M
%company	Setting of meta data: company name	-	20 character (ASCII)	*Empty*
%machine	Setting of meta data: machine/plant name	-	20 character (ASCII)	*Empty*
%article1	Setting of meta data: article number/name 1	-	20 character (ASCII)	*Empty*
%article2	Setting of meta data: article number/name 2	-	20 character (ASCII)	*Empty*
%article3	Setting of meta data: article number/name 3	-	20 character (ASCII)	*Empty*
%SO3Interface	Setting of printer interface		See chapter	9600 N X D
%SO4Interface	Setting of protocol interface		See chapter	115200 N X D

14.3 Error numbers

All error messages begin with the letter 'E' and a two-digit error number. The last five errors that occurred are cached during the operation from error code 'E10' on. The command *Error* shows the numbers and error texts. The short command *X*, on the contrary, returns only the last error code. Certain critical and fatal errors will be stored permanently and can be retrieved by calling the command ListError.

Critical errors mostly demand a modification of the programming or the use conditions. Activating the command *Error* deletes this error from the list

Fatal errors indicate severe hardware errors. The measuring function is switched off in such a case. The device must be checked. These errors are not deleted from the list by activating the command *Error*.

Further descriptions appear in brackets in some error texts that are self-explanatory in the following table.

Table 13: Error codes of VLM500

Code	Description	Cause of error
E00 No ERROR	No error occurred	-
E01 Missing parameter	No or too few parameters specified	Incorrect command input
E02 Value out of range	Number too small or too big	Incorrect command input
E03 Invalid command	Non-existent command	Incorrect command input
E04 Invalid parameter	Parameter not allowed	Incorrect command input
E05 No data	No data in memory	Offline Measurement
E06 Memory full	Memory full	Too many measured values during offline measurement
E07 ESC user abort	Abort by ESC	Offline measurement and calibration
E08 Calibration Error	Faulty calibration	Dropout during the calibration
E09 Illegal Use	Input disabled for 60 s	Password entered incorrectly 3 times
E10 SO1 output error	Error during S1 output	Output too fast
E11 SO1 input error	Parity error, buffer overflow etc.	Transmission error, see *SO1Interface*
E12	*not in use*	
E13 SO2 output error	Error during S2 output	Output too fast
E14 SO2 input error	Parity error, buffer overflow etc.	Transmission error, see *SO2Interface*
E15 – E16	*not in use*	
E17 Analog output error	Error during analog output	Output too fast
E18 Incremental output error	Error during pulse output	Output too fast
E19 Offline output error	Error during offline measurement	Measurement too fast
E20 Warning, check MODE and VMAX	Overflow	Check settings of *Mode* and *Vmax*, refer to data sheet
E21	*not in use*	
E22 Warning, AVERAGE adjusted	Value too short chosen for AVERAGE	The internal signal processing is faster than the AVERAGE value
E23 VMAX too large for 'direction a'	VMAX too high for automatic direction detection	DIR is set to auto and VMAX setting is too high for the automatic direction detection

Code	Description	Cause of error
E24 No direction board found	The entered command is not accepted because an automatic direction detection is not installed	Setting DIR to auto is not allowed without an automatic direction detection board (DIRB)
E25 Output is busy, please try again later!	Command blocked by other interface	Commands requiring an input such as *Test*, *TestAO*, etc. cannot be executed simultaneously on both interfaces S1 and S2
E26 Warning, Signal error during length measurement	Faulty length measurement	Signal dropout during length measurement
E27 Warning, FPGA overflow detected!	Measuring values lost	The measuring value cache was exceeded.
E28 – E29	*not in use*	
E30 Periods out of range	Error in signal processing	Invalid number of periods
E31 Over temperature detected!	Internal temperature higher than 75 °C	Switch of the device immediately, cooling required
E32 LED voltage error detected!	Light source defect. Too high voltage	Light source is defect and must be replaced Contact service!
E33 Watchdog timer reset	Reset by watchdog	Processor crashed (also during overload)
E34 LED current error detected!	Light source defect. Too high current	Light source is defect and must be replaced Contact service!
E35 I²C arbitration error detected	Internal software error	Unknown error on the internal I²C-Bus
E36 I²C counter level changed	Internal software error	Unknown error on the internal I²C-Bus
E37 I²C time out occurred	Internal software error	Unknown error on the internal I²C-Bus
E38 I²C control part reset	Internal software error	Unknown error on the internal I²C-Bus
E39 I²C initialization of registers	Internal software error	Unknown error on the internal I²C-Bus
E40 Error reading PARAMETER, contact vendor!	An error occurred while transferring the parameters from FLASH to RAM	Fatal error, contact your local vendor or the manufacturer
E41 PARAMETER set not existing or set invalid	The parameter set to be loaded does not exist or is invalid	If the set is not existing, it will be created automatically
E42 Wrong PARAMETER version, contact vendor!	The parameter set to be loaded has the wrong version	Fatal error, contact your local vendor or the manufacturer
E43	*not in use*	
E44 Parameter not stored!	Parameter could not be stored!	Fatal error, device must be repaired
E45 FPGA reset failed!	Faulty reset of the FPGA	Fatal error, device must be repaired
E46 Too high frequency!	Plausibility Error	Measured data are wrong

Code	Description	Cause of error
E47 – E49	*Not in use*	
E50 Analog 12V out of range	The voltage 12V is out of range	24V voltage supply is instable Internal hardware error
E51 Analog 5V out of range	The voltage 5V is out of range	24V voltage supply is instable Internal hardware error
E52 Analog -5V out of range	The voltage -5V is out of range	24V voltage supply is instable Internal hardware error
E53 Analog -12V out of range	The voltage -12V is out of range	24V voltage supply is instable Internal hardware error
E54 Digital 5V out of range	The voltage 5Vdd is out of range	24V voltage supply is instable Internal hardware error
E55 Digital 1.2V out of range	The voltage 1.2V is out of range	24V voltage supply is instable Internal hardware error
E56 – E59	*not in use*	
E60 FPGA (ADSC) not found	No availability of signal processor	Internal Hardware error
E61 SRAM not found	No availability of SRAM	Internal Hardware error
E62 FRAM not found	No availability of FRAM	Internal Hardware error
E63 RTC not found	No availability of Real time clock	Internal Hardware error
E64 DAC not found	No availability of digital analog converter	Internal Hardware error
E65 FB not found	No availability of filter board	Internal Hardware error
E66 DTS not found	No availability of digital temperature sensor	Internal Hardware error
E67 TERM not found	No availability of terminal board	Internal Hardware error
E68 – E79	*not in use*	Internal Hardware error
E80 Non valid hex file	Wrong format	No valid file
E81 Illegal address range	Wrong address range	No valid file
E82 User terminated	Cancellation	Transmission interrupted
E83 Checksum Error	Error checksum calculation	File error
E84 Verification error, no valid program in flash memory	Check after programming failed	Do not switch off the device and do not leave the boot loader! Try again with command *Update*.
E85 No target device to update found	There is no fieldbus module installed in the VLM, for which an update could be executed	The ‘update f’ – command was called regardless of an installed fieldbus module
E86 Hex file not valid for this gauge	File is not suitable for this device	No valid file for this device.
E87 Hex file not valid for the selected target	The selected FW-file doesn’t correspond to the selected board (ADSC or IPUN)	Wrong file was selected.

Table 14: Error codes of CDB

Code	Description	Cause of error
E00 No ERROR	No error occurred	-
E01 Missing parameter	No or too few parameters specified	Incorrect command input
E02 Value out of range	Number too small or too big	Incorrect command input
E03 Invalid command	Non-existent command	Incorrect command input
E04 Invalid parameter	Parameter not allowed	Incorrect command input
E05 No data	No data in memory	Offline Measurement
E06	*Not in use*	
E07 ESC user abort	Abort by ESC	Operation was aborted by user
E08	*Not in use*	
E09 Illegal Use	A legally relevant parameter should be changed	User tried to change a legally relevant parameter
E10 so[0] output error	Error during S1 output	Output too fast
E11 so[0] input error	Parity error, buffer overflow etc.	Transmission error
E12	*not in use*	
E13 so[1] output error	Error during S2 output	Output too fast
E14 so[1] input error	Parity error, buffer overflow etc.	Transmission error
E15 so[2] output error	Error during S3 output	Output too fast
E16 so[2] input error	Parity error, buffer overflow etc.	Transmission error
E17 so[3] output error	Error during S4 output	Output too fast
E18 so[3] input error	Parity error, buffer overflow etc.	Transmission error
E19 – E24	*not in use*	
E25 Output is busy, please try again later	Command blocked by other interface	
E26 – E31	*not in use*	
E33 Watchdog timer reset	Reset by watchdog	Processor crashed (also during overload)
E34 LED current error detected!	Light source defect. Too high current	Light source is defect and must be replaced Contact service!
E35 I²C arbitration error detected	Internal software error	Unknown error on the internal I²C-Bus
E36 I²C counter level changed	Internal software error	Unknown error on the internal I²C-Bus
E37 I²C time out occurred	Internal software error	Unknown error on the internal I²C-Bus
E38 I²C control part reset	Internal software error	Unknown error on the internal I²C-Bus
E39 I²C initialization of registers	Internal software error	Unknown error on the internal I²C-Bus
E40 Memory Full		
E41 Day storage limit reached		
E42 Error while saving		
E43 – E60	*Not in use*	
E61 CDB SRAM not found	No availability of SRAM	Internal Hardware error
E62 CDB FRAM not found	No availability of FRAM	Internal Hardware error
E63 CDB RTC not found	No availability of Real time clock	Internal Hardware error
E64 CDB SDCARD not found	Error with SDCARD	Internal Hardware error or SDCARD not inserted
E65 Fatal VLM error received	CDB received a fatal error code from the VLM	several

14.4 Terminal assignment

Device connection VLM500 1, 4

The terminal assignment of the connections 1 and 4 are wired according to customer specification and displayed in the enclosed documents.

Device connection VLM500 5

The device connection 5 is dedicated for the output of the process data. The following table shows the pin assignment of connection 5. Connection type: 4 pole, plug female, D coding.

Table 15: Device connection 5, VLM

Pin number	Profinet IO, EtherNet/IP, Ethernet
1	T+
2	R+
3	T-
4	R-
5	*No Connection*

Device connection VLM500 3

Table 16: Device connection 3, VLM

Pin number	Color cable	Assignment 24V/DC
3	black 1	0 Volt
4	black 2	24 Volt
PE	green/yellow	Protective Earth

Caution: Ground the device with the grounding cable before connecting it to the current supply.

Device connection CDB 3

The device connection 3 is intended for the parameterization of the VLM500-MID. Physically, it is a USB interface that is installed on the PC as a virtual COM port. The following table shows the pin assignment of connection 3. Connection type: 5 pole, plug female, A coding.

Table 17: Device connection 3, CDB

Pin number	Color	USB
1	Brown	5V
2	White	D-
3	Blue	GND
4	Black	D+
5	Grey	*No connection*

Device connection CDB 4

The device connection 4 is intended for the connection of switching inputs and outputs. The following table shows the pin assignment of connection 4. Connection type: 8 pole, plug female, A coding.

Table 18: Device connection 4, CDB

Pin number	Color	
1	White	Direction +
2	Brown	Trigger +
3	Gree	Direction - / Trigger -
4	Yellow	Error + / Status + / Length I + / Length II +
5	Grey	Error -
6	Pink	Status -
7	Blue	Length I -
8	Red	Length II -

Device connection CDB 5

Device connection 5 is used for the data output of the CDB. The pin configuration depends on the type of the interface. The following table shows the pin assignment of connection 5

Table 19: Device connection 5, CDB

Pin	Color	RS-232	RS-4xx 2 wire	RS-4xx 4 wire	USB	Profinet IO, EtherNet/IP, Ethernet
		5 pole plug female, A coding	5 pole plug female, A coding	5 pole plug female, A coding	5 pole plug female, A coding	4 pole plug female, D coding
1	Brown	RxD	R+ / T+ / A	R+ / A	5V	T+
2	White	TXD	R- / T- / B	R- / B	D-	R-
3	Blue	GND	*No connection*	T- / Z	GND	T-
4	Black	*No connection*	*No connection*	T+ / Y	D+	R+
5	Grey	*No connection*	*No connection*	*No connection*	*No connection*	*No connection*

Device connection CDB 6

The device connection 6 is used to connect a printer. The following table shows the pin assignment of connection 6. Connection type: 5 pole, plug, A coding

Table 20: Device connection 6, CDB

Pin number	Color	
1	Brown	RxD
2	White	TxD
3	Blue	GND
4	Black	*No connection*
5	Grey	*No connection*

14.5 Plug connector

Assembly instructions for plug connector M12

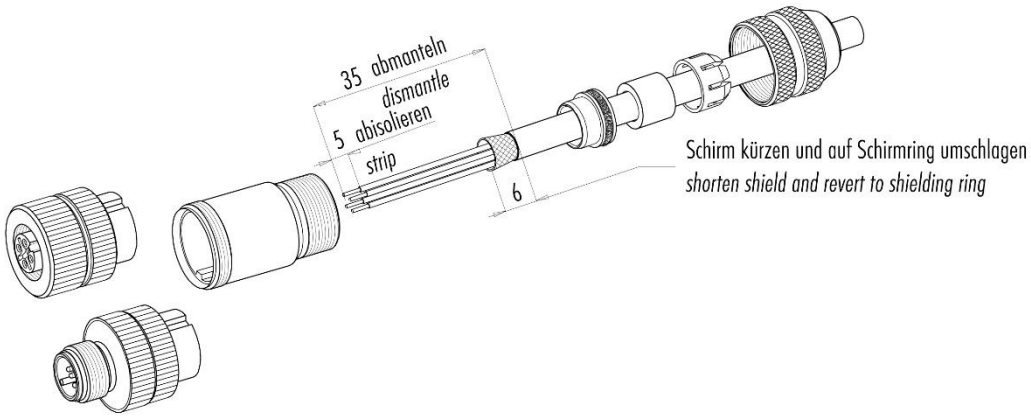


Figure 35: Assembly instruction for shielded plug connectors connections 1, 2, 4 and 5

This connector can be connected to ports 1, 4 and 5 on the VLM500 and to ports 2, 3, 4 and 5 on the CDB.

Assembly instructions for plug connector 3, VLM500

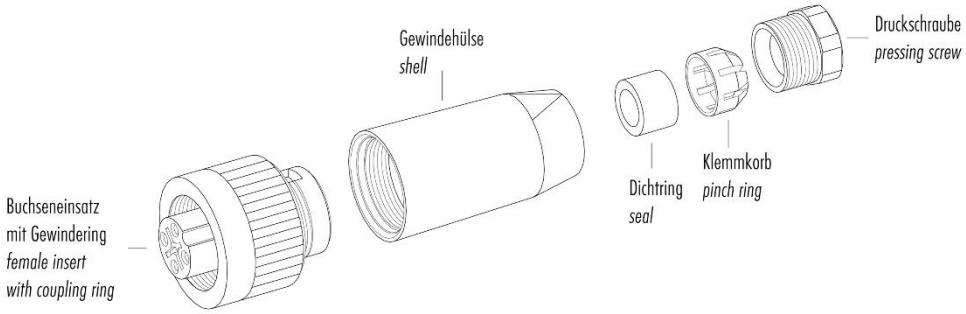
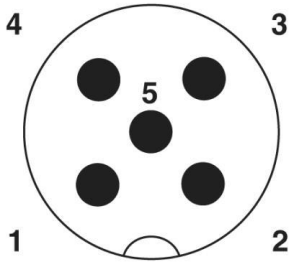
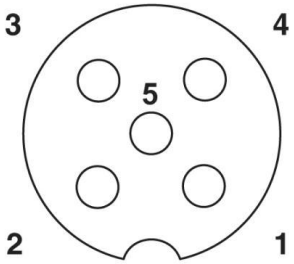
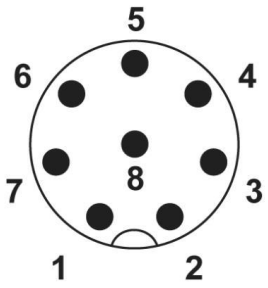
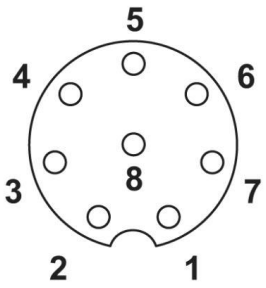


Figure 36: Assembly instruction for shielded plug connectors connection 3, VLM500

Contact assignment cable plugs and cable boxes

Cable plug 5 pole, M12, A coding RS-232	**Cable plug 5 pole, M12, A coding** Different inputs and outputs, e.g. analog output
	
Cable plug 8 pole, M12, A coding Pulse output 5V	**Cable box 8 pole, M12, A coding** digital inputs and outputs (IN, OUT)
	

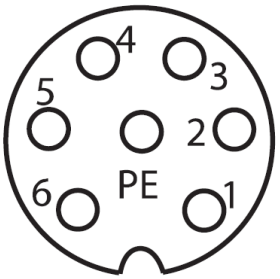
Cable box 7-polig, RD24, Series 693 Input 24V DC


Figure 37: Assignment of the plug connector (Display on the plug page)

14.6 Dimensional and installation drawings

All dimensions in mm.

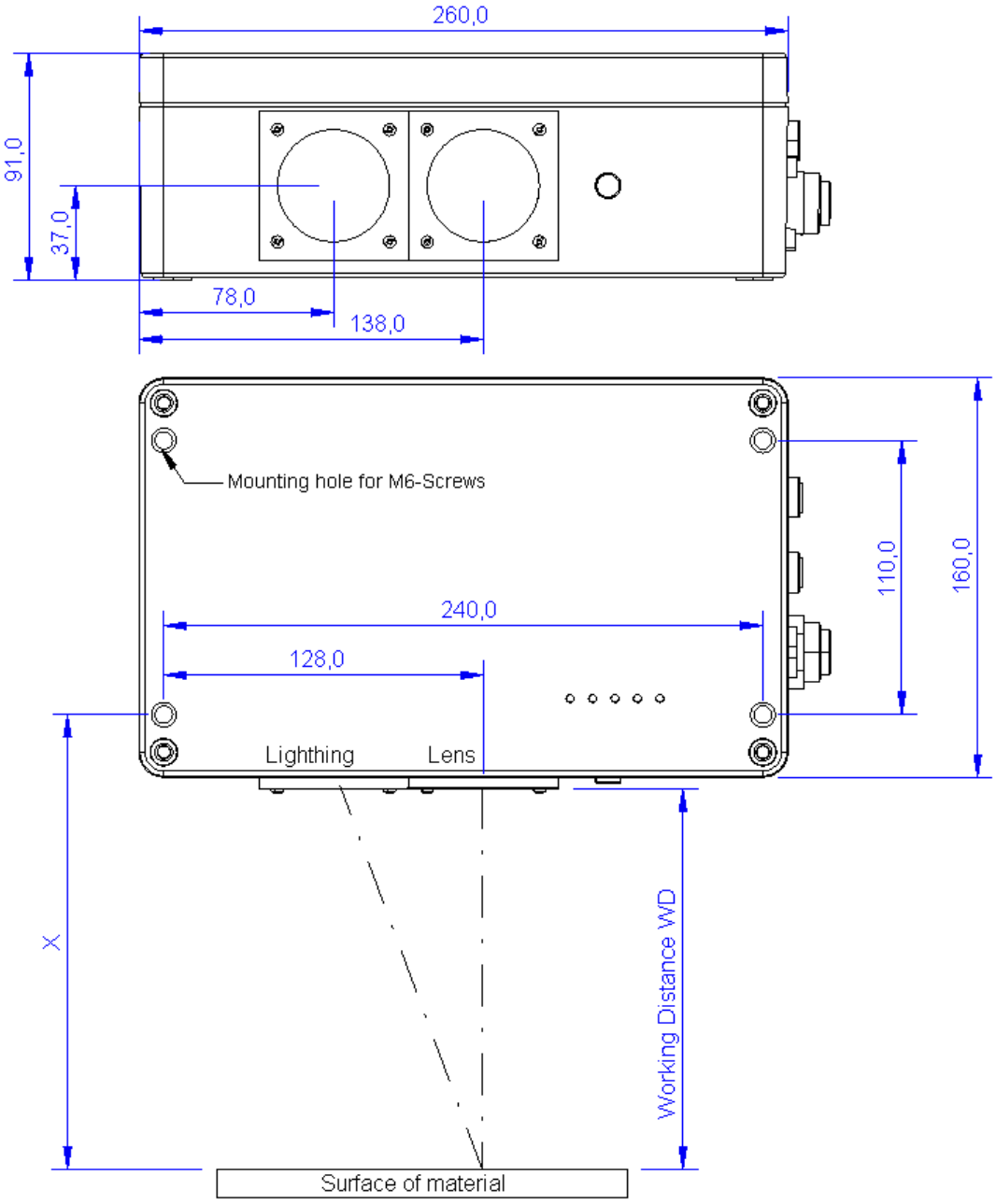


Figure 38: Dimensional and installation drawings for VLM500

Device	WD [mm]	X [mm]
A-Series	185	215
D-Series	240	270
L-Series	185	215
E-Geräts	330	360

The working distance (WD) is always measured starting at the objective window.

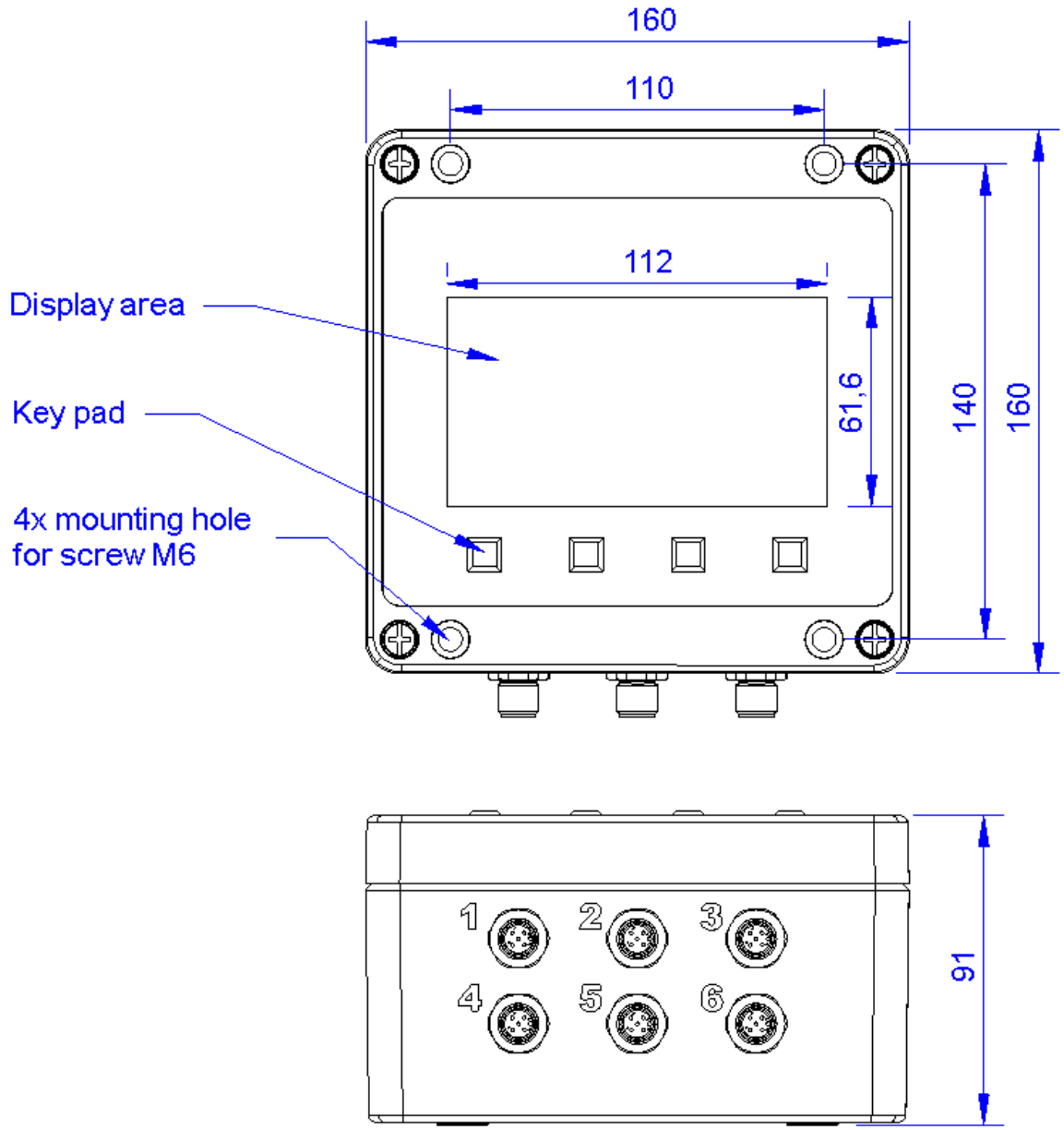


Figure 39: Dimensional and installation drawings for CDB

15 Declaration of conformity

Manufacturer	**ASTECH Angewandte Sensortechnik GmbH**
Address	18057 Rostock
	Schonenfahrerstr. 5
	Germany
Product name	VLM500
Description	Optical length and velocity measuring device

This product (seen as a counter) was checked by the German *Physikalisch Technische Bundesanstalt PTB* with respect to the **WELMEC-guide 8.8**.

The manufacturer declares conformity to the **EC-guide 2014/30/EC** (EMC) and conformity to the **EC-guide 2014/32/EC** (MID) seen a part (counter) of a length measuring machine. The requirements to the built-in software comply with the **WELMEC-guide 7.2**. Furthermore, the product follows the **OIML-guide D 11** and the **OIML-recommendation R 66**.

The following EMC-guides have been applied to comply with **EC-guide 2014/30/EC** (EMC):

Basic standard DIN EN 61326-1:2012

Emitted interference (classification: group 1, class A):

IEC/CISPR 11:2015; grid-bound emission

IEC/CISPR 11:2015; radiated emission

Interference immunity (classification: Industrial electromagnetic environment):

IEC 61000-4-2:2008 Electrostatic discharge (ESD)

IEC 61000-4-3:2010 Electromagnetic field

IEC 61000-4-4:2012 Electrical Fast Transient / Burst

IEC 61000-4-5:2014 Surge immunity

IEC 61000-4-6:2013 Conducted disturbances induced by RF fields

Place	Rostock
Date	June 2020

ASTECH Angewandte Sensortechnik GmbH

Jens Mirow

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